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POWER

MARCH, 1945

POWER GENERATION, TRANSMISSION, APPLICATION AND THE ATTENDANT SERVICES IN ALL INDUSTRY

Outdoor reducing, desuperheating station serving a West Coast refinery plant

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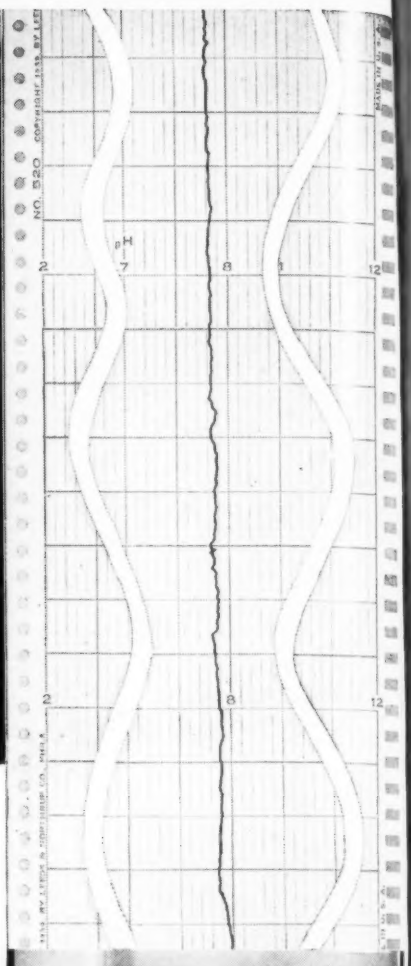
Page 59

Hydraulic Drives: Special 8-page section devoted to hydraulic couplings, torque converters, variable-speed transmissions. Sixteen diagrams in color make it easy to learn how these units work. Built for almost any capacity from ½ hp up, they connect internal-combustion engines and electric motors to their loads. Starts p 179

"How to" articles: Burning sawdust, hogged fuel and chips efficiently, p 68; selecting power plant cleaning materials and methods, p 74; taking color out of boiler-water test samples, p 103



Micromax pH Control, feedwater plant, Wyandotte Chemicals, Inc., Wyandotte, Mich. Right, typical pH chart of finished water in a holding tank.

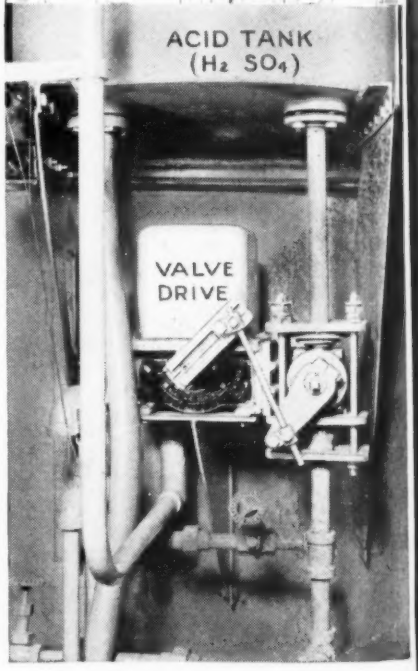
Wyandotte Plant Holds pH to ± 0.2 With Micromax Recording Controller

Faced with the problem of reducing the pH of feedwater from 10.1 to 7.9, Wyandotte Chemicals, Inc., use an L&N Micromax automatic Recording Controller to do the job. The pH is reduced — and held within a band only ±0.2 wide.

The pH of the raw water, from the Detroit River, is 7.5. The water treating cycle begins with a lime soda softening, then phosphate softening, after which the water is deaerated and filtered. Following filtration, the pH measures 10.1. To reduce it to 7.9, sulfuric acid is added by means of the Micromax Electric Control valve, shown at the right. Finished water, when measured at the end of the treating process, is within ±0.2 of the ideal. Valuable man hours are saved that would be expended in a manual method of control, and waste of acid is eliminated. The Micromax Controller also supplies a continuous graphical record, on a chart almost ten inches wide. It is large and bold enough to be read quickly and accurately by any workman.

Corrosion worries don't exist. The closeness of control at the desired pH value prevents corrosion of piping and simplifies the handling of other factors which are influenced by the pH of the feedwater.

Further details of L&N Micromax automatic pH Recording Controllers are available in Catalog N-96(1), which will be sent on request. If you have a specific pH problem in mind, and will outline it, an L&N engineer will be glad to send further information.



Micromax Electric Control valve drive on reagent sulfuric acid.

Jrl Ad N-96-701(4)

ARMY ★★ NAVY

depends on me!

A Slogan For Every American

LEEDS & NORTHRUP COMPANY, 4910 STENTON AVE., PHILA. 44, PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

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TECHNOLOGY DEPT.

BULK-FLO *Solves a Coal Handling Problem in Wire Plant Boiler Room*

MAR 6 1945

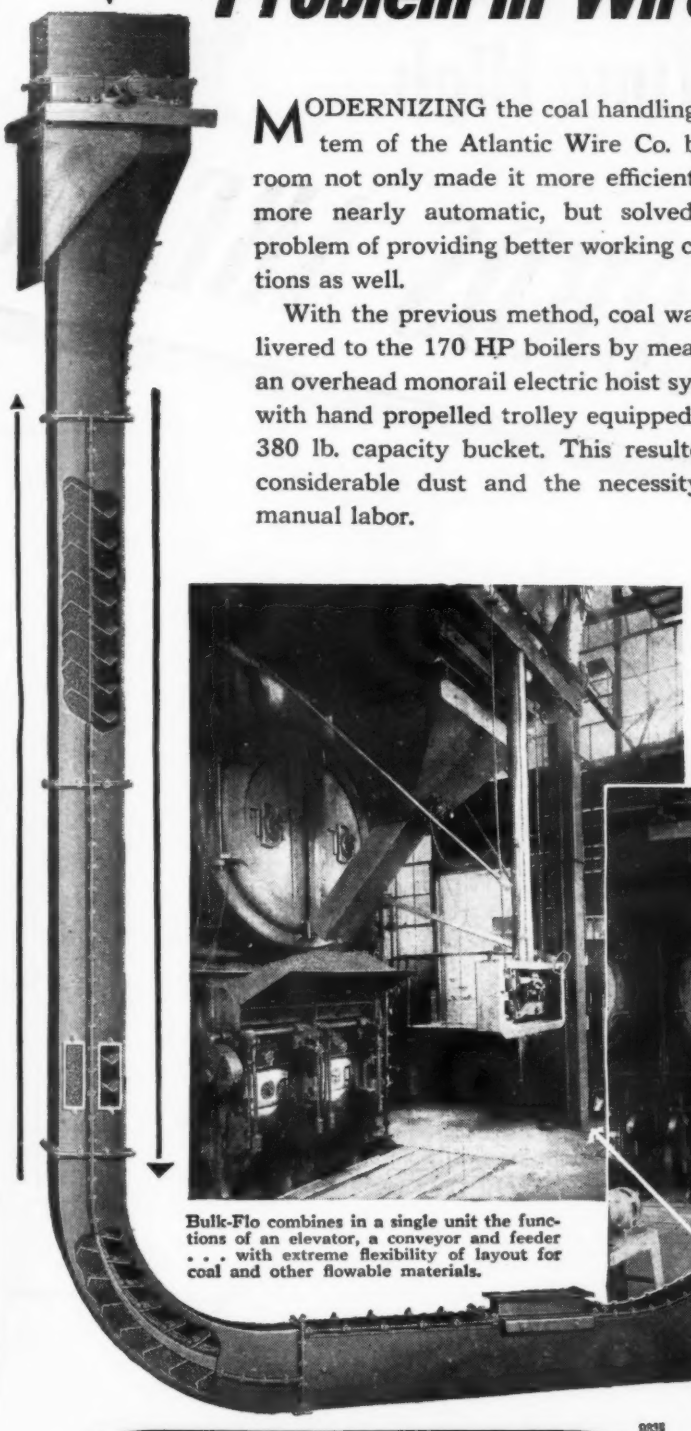
MODERNIZING the coal handling system of the Atlantic Wire Co. boiler room not only made it more efficient and more nearly automatic, but solved the problem of providing better working conditions as well.

With the previous method, coal was delivered to the 170 HP boilers by means of an overhead monorail electric hoist system, with hand propelled trolley equipped with 380 lb. capacity bucket. This resulted in considerable dust and the necessity for manual labor.

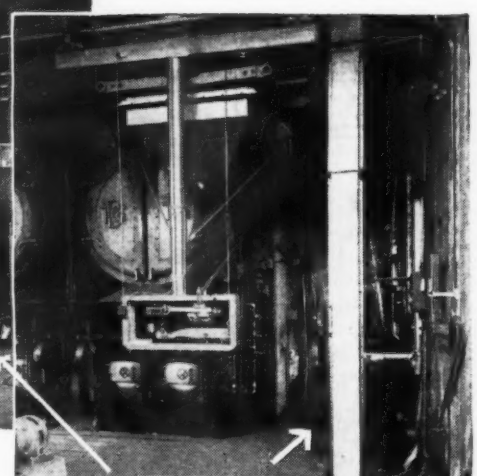
With the Bulk-Flo conveyor-elevator, the coal storage pit is outside the boiler room wall. Slide gates in the wall lower the coal to the horizontal section of the Bulk-Flo. The vertical section delivers the coal to a suspended weigh larry, equipped with chute to hand-operated undercut gate to regulate discharge to stoker hopper. The weigh larry also has an electric vibrator to prevent wet coal from sticking to the inside walls. Link-Belt is prepared to help you solve similar problems. Send for Catalogs.

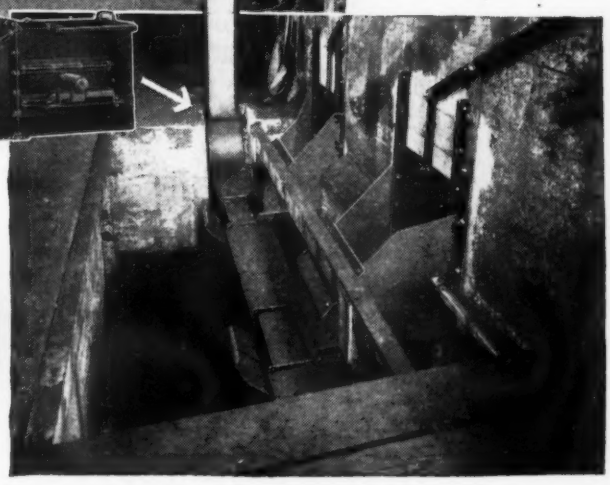
LINK-BELT COMPANY

Chicago 8, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in principal cities.



Bulk-Flo combines in a single unit the functions of an elevator, a conveyor and feeder . . . with extreme flexibility of layout for coal and other flowable materials.





At left: Vertical run of Link-Belt Bulk-Flo; boilers; and hand-propelled weigh larry. Below: Wall gates and chutes to horizontal run of Link-Belt L-path Bulk-Flo conveyor-elevator.

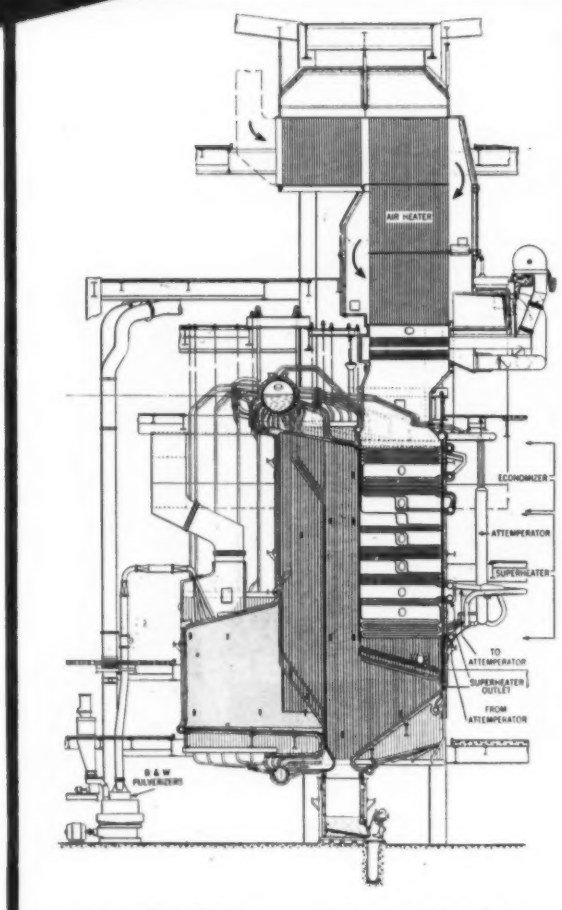
9838

LINK-BELT

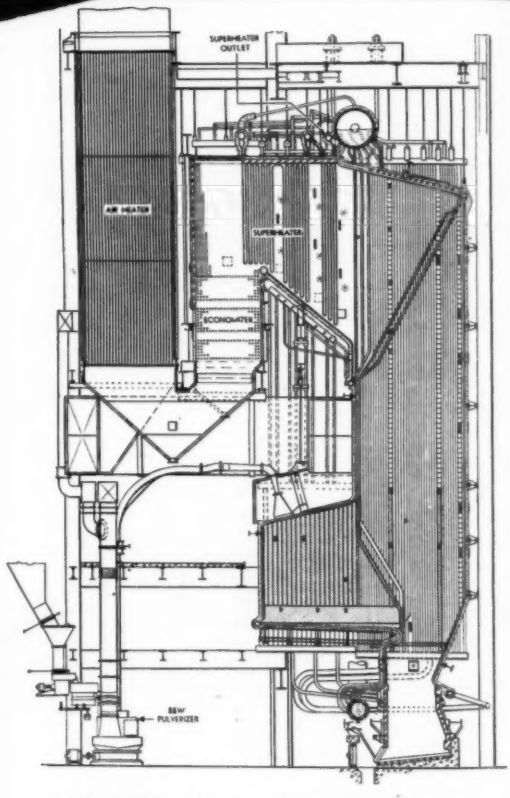
Bulk-Flo

ELEVATOR-CONVEYOR-FEEDER

NEW RECORDS ARE AN O



Open-Pass Boiler in an eastern central-station—capacity 900,000 lb. steam per hr.



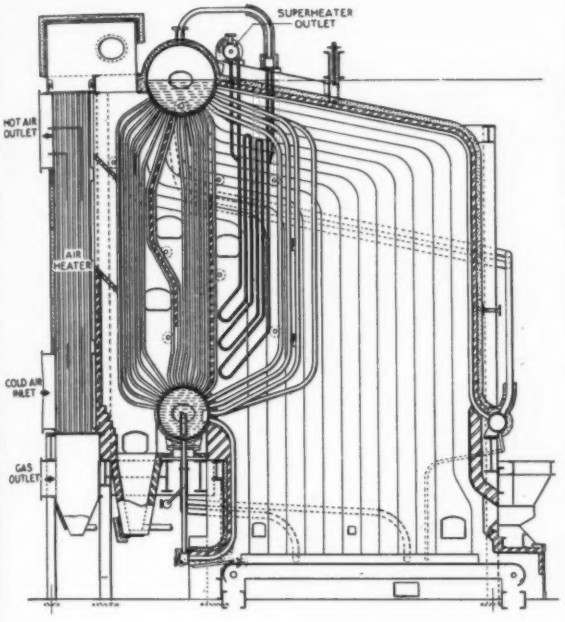
Radiant Boiler in an eastern central station—capacity 900,000 lb. steam per hr

BUY WAR BONDS!

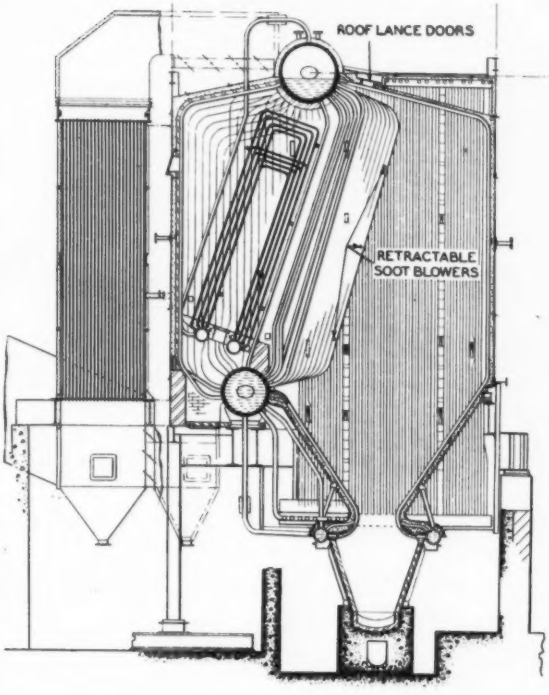
★ ★ ★

BUY MORE THAN BEFORE

OLD STORY WITH B&W BOILERS



Stirling Boiler in a western manufacturing plant—capactiy 115,000 lb. steam per hr.



Integral-Furnace Boiler in a mid-western steel plant—capacity 169,000 lb. steam per hr.

To managements, engineers, and operating personnel of public utilities and industrial power plants throughout the nation, B&W too, says "WELL DONE" for another year of distinguished war-time achievement.

Your accomplishment in meeting the increased war-urgent power demands for war production and civilian consumers, also added another outstanding chapter to past performance records of B&W Boilers. By providing a large part of your 1944 steam requirements, B&W installations—Radiant, Open-Pass, High-Head, and Integral-Furnace—continued to demonstrate their high availability for service, reliability, and economical performance under unprecedented operating conditions. Along with these more recent B&W designs, Cross-Drum and Stirling boilers also upheld the impressive performance for which they have been so well known for decades.

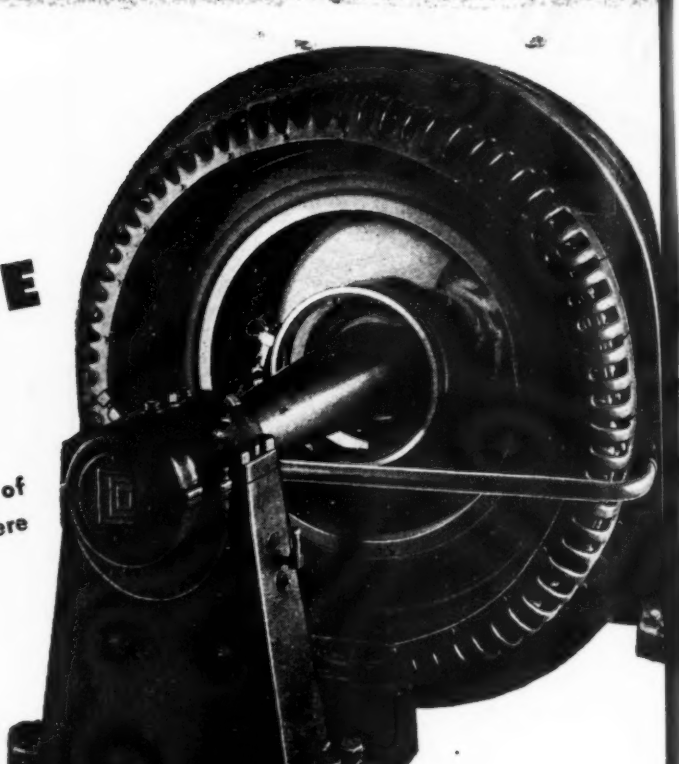
This proved ability of your B&W boilers to deliver large blocks of steam reliably and economically, even under adverse circumstances, is a factor to keep in mind when boilers are needed for future replacements or expansion. It is an indication of how closely B&W designs are matched to the requirements of each job. It is a good reason why you will want to draw again on our long experience in designing, building, and applying steam-generating equipment—experience which cannot be written into specifications or shown on blue-prints, but which is inherent in every B&W Boiler.

BABCOCK & WILCOX

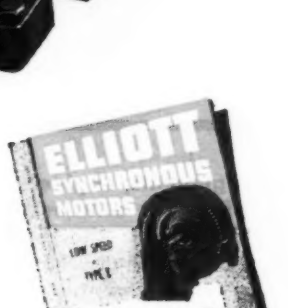
THE BABCOCK & WILCOX CO.
85 Liberty St., New York 6, N. Y.

Two exceptional motors

Low-speed synchronous—Type E



- Operates at 450 rpm and below—
- Squirrel cage windings in rotor of famous Elliott diamond cage type where required—
- Windage and magnetic noises are kept to a minimum—
- Motors are specially adapted and built for their specific service—
- Efficiency as high as possible consistent with good engineering practice—
- Materials used are the best obtainable . . . workmanship is uniformly of highest standard—
- THESE ARE EXCEPTIONALLY STURDY MOTORS, RECOMMENDED FOR LOW-SPEED DRIVES, WHERE MANY YEARS OF SERVICE ARE CONTEMPLATED.



Many exceptional construction features covered in the new bulletin — Write.

ELLIOTT

by ELLIOTT

igh-speed
wo-pole—
splash-proof

- Smooth, streamlined appearance—
- Substantial cast iron frames and brackets—quiet, stiff, vibrationless—
- Rotor bearings rigidly braced from base—
- Rotor carefully balanced dynamically and statically—
- Rotor winding designed for the service required. Elliott diamond cage construction used where exceptional strength is needed—
- Substantial, roomy conduit box—
- Construction minimizes windage and magnetic noises—
- Controlled ventilation assures cool operation—
- A PARTICULARLY SERVICEABLE HIGH-SPEED MOTOR, BUILT TO ELLIOTT STANDARDS THROUGHOUT.

New bulletin just published, covers interesting construction details. Write.

L-701

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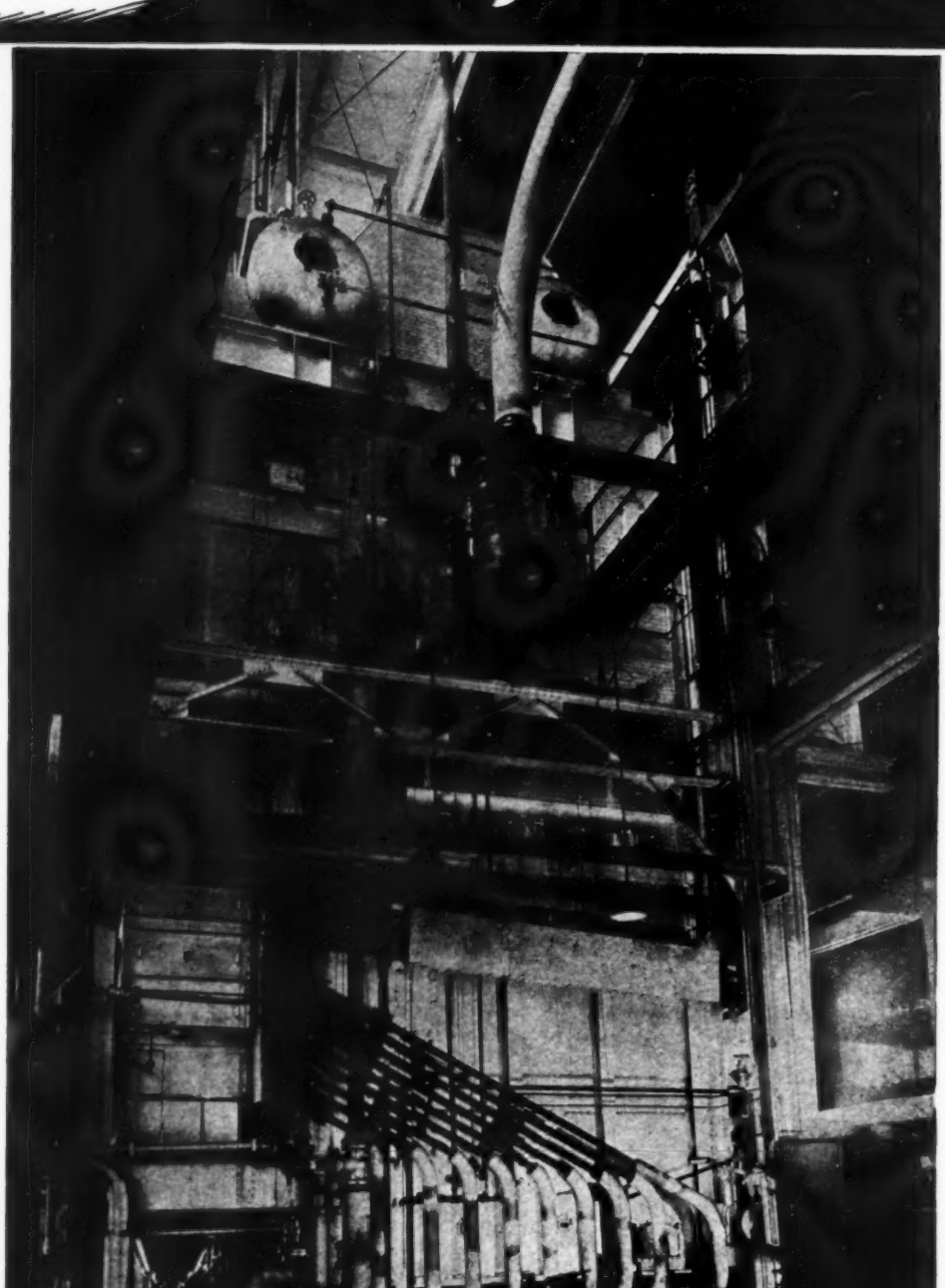
MAKERS OF: STEAM TURBINES • GENERATORS • MOTORS CONDENSERS • FEEDWATER HEATERS AND DEAERATORS STEAM JET EJECTORS • CENTRIFUGAL BLOWERS • TURBO-CHARGERS FOR DIESEL ENGINES • TUBE CLEANERS STRAINERS • DESUPERHEATERS • FILTERS

1940
1944
Duplicate



FW
FOSTER

Steam Generator

ORIGINAL UNIT EXCEEDED GUARANTEED EFFICIENCY AND MAINTAINED GUARANTEED CAPACITIES

Four years ago a large industrial plant installed a Foster Wheeler Bent Tube Steam Generator. Plant expansion recently necessitated additional steam capacity and a duplicate boiler was ordered. Determining factors which influenced this selection were the consistently low maintenance and high average yearly efficiency of the first unit. Efficiency for 1942 was 82.8%*, and for 1943, 82.6%* when burning midwest coals at a continuous load of 175,000 lb. of steam per hour, at 225 psi, 515 deg. F. final steam temperature and 215 deg. F. feed water to unit.

These Steam Generators are of the three drum, bent tube design and include completely water-cooled furnaces, superheaters, economizers and are fired with spreader type stokers.

*Design efficiency 83%. Corresponding test efficiencies approximate 84.5%.

FOSTER WHEELER CORPORATION
165 Broadway **New York 6, New York**

WHEELER

With DIAMOND AUTOMATIC

JUST PUSH A BUTTON

and the Automatic Control makes sure that all Soot Blowers operate in Proper Sequence and at the Right Speed . . . none can be overlooked.

CORRECT CLEANING IS ASSURED AND BOTH FEED WATER AND LABOR ARE SAVED.

Just push a button . . . that's all you do to clean the entire boiler, superheater, economizer, and air heater (whether soot blower elements are fixed or retracting). All blowers then operate in proper sequence and at the correct blowing speed. No blower can be overlooked or incorrectly operated by a careless operator. This automatic operation entirely eliminates the need for an attendant.

The program panel shown above controls both retracting and nonretracting blowers arranged in three groups; any desired number of groups can be had when system is designed. One "start" button controls all groups, but any group can be operated independently of other groups if desirable by simply throwing a switch on the panel. Blowing sequence of the units in any group can also be easily altered to suit changed conditions.

Compressed air has a greater density than steam and therefore provides better cleaning. The air is discharged from permanently installed elements (see bottom of right-hand page) in a series of short puffs with substantial pauses between. Spreading the cleaning cycle over a longer period of time eliminates stack discharge nuisance and permits use of a much smaller compressor.

Diamond Automatic Sequential Air Soot Blowing Systems have been in very successful central station use since 1940. For further information, write for Bulletin No. 956 which illustrates and describes an installation on a 900,000 lb/hr boiler in a modern eastern central station.

DIAMOND POWER SPECIALTY

DIAMOND SPECIALTY

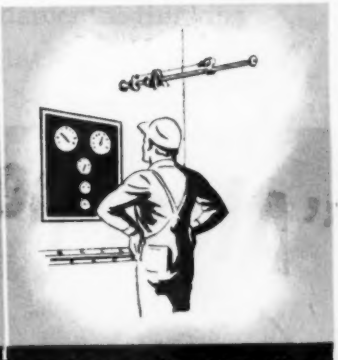
SEQUENTIAL AIR SOOT BLOWING

INSTEAD OF THIS

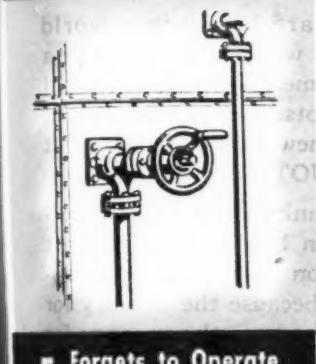
1 Opens Drain and Main Steam Valves

2 Drains and Warms Up Piping

3 Operates Blower No. 1 Too Fast



4 Operates Long Retracting Blower No. 2



5 Forgets to Operate Blower No. 3

6 Operates Blowers No. 4, 5, etc.

7 Closes Main Steam Valve

Considerable Time of an Attendant is required to Operate Conventional Soot Blowers . . . *AND THERE IS NO ASSURANCE THE WORK WILL ALWAYS BE CORRECTLY DONE!*

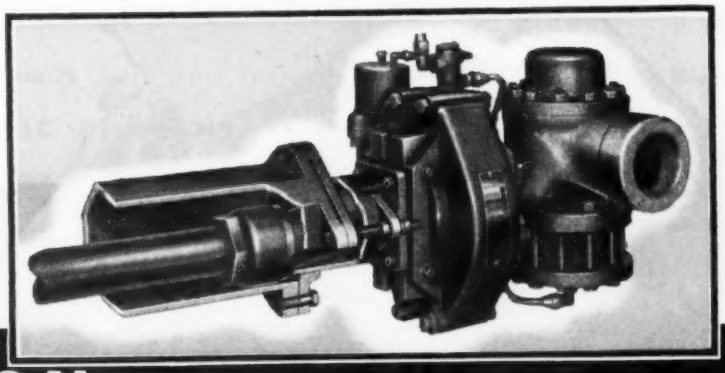
OTHER ADVANTAGES of DIAMOND Automatic Sequential AIR SOOT BLOWERS

NO FEED WATER MAKEUP—Using compressed air instead of steam as the cleaning medium, there is no condensate loss due to soot blowing. This is particularly important where makeup water is a problem.

SAVES FUEL—Experience gained during several years' operation on a number of installations indicates that automatic sequential air puff soot blowing uses only ⅓ to ⅔ of the energy from the coal pile that is needed for steam blowing.

REDUCES MAINTENANCE—Experience on two 900,000 lb/hr boilers placed in operation in 1940 and one 900,000 lb/hr and one 550,000 lb/hr units installed in 1942 has proved the maintenance cost is unusually low.

ELIMINATES PIPING INSULATION—When air is used for cleaning, the soot blower piping is not insulated.



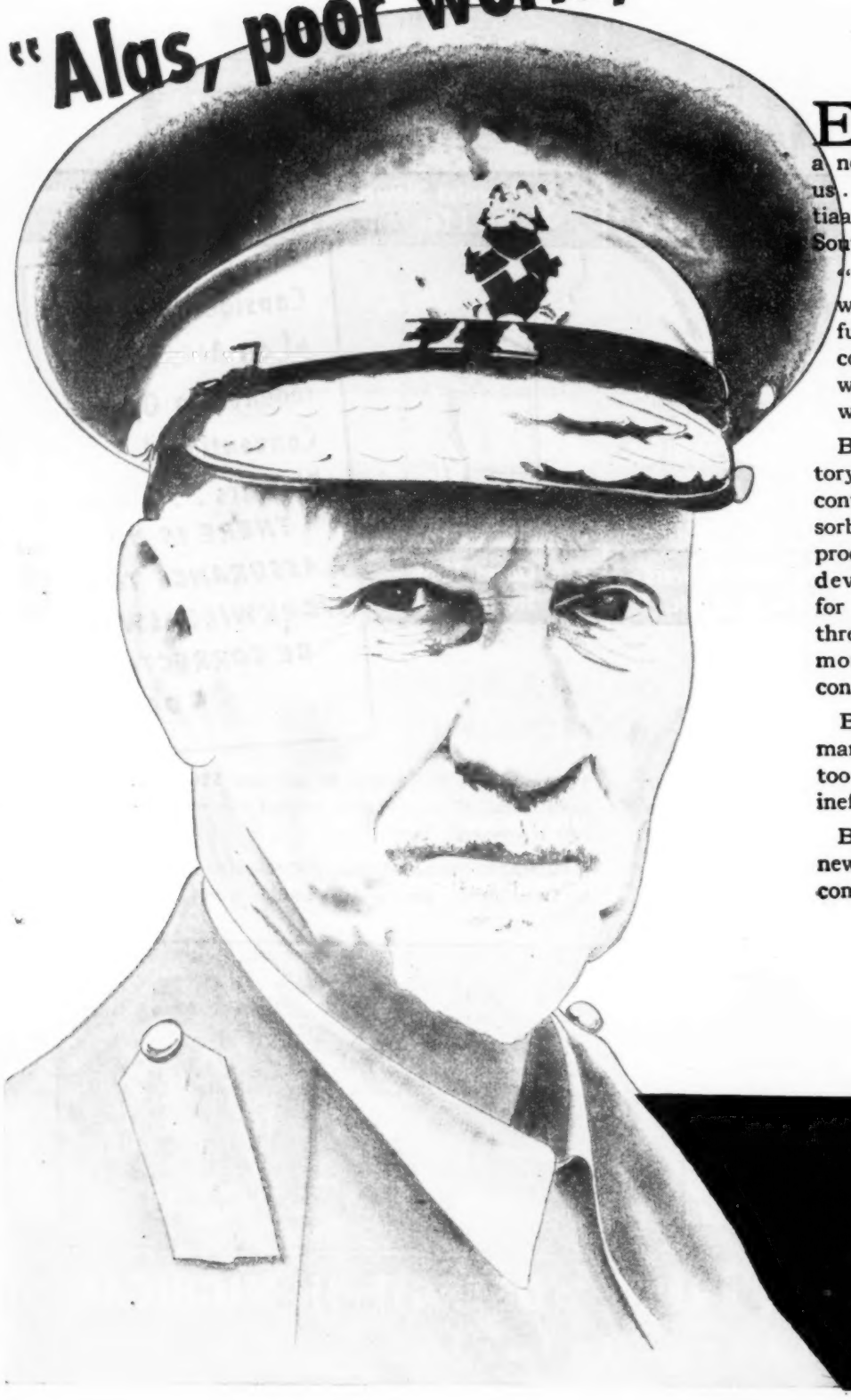
At right is the Diamond Air Puff Soot Blower having element permanently installed inside the setting; various types of retracting soot blowers are also used in the Diamond Automatic Sequential Air Soot Blower System.

CORPORATION • DETROIT 31, MICHIGAN

LTD., Windsor, Ontario

then he said to himself

"Alas, poor world, I knew it well"



EXPLAINING how the old map is being rolled up and a new map is unrolling before us . . . Field Marshal Jan Christiaan Smuts, Prime Minister of South Africa, went on to warn:

"We are living in a world where we are FORCED to a fundamental revision of old concepts. The old world that we knew has GONE and it will NOT RETURN!"

Be thankful that to many factory men here in America that conviction has already been absorbed, because the urgency for production . . . the urgency for development...the urgency for redesign has made evident, throughout these critical supply months, the need for better concepts.

By following old concepts in manufacture, the materiel flowed too little and too late and too ineffectively.

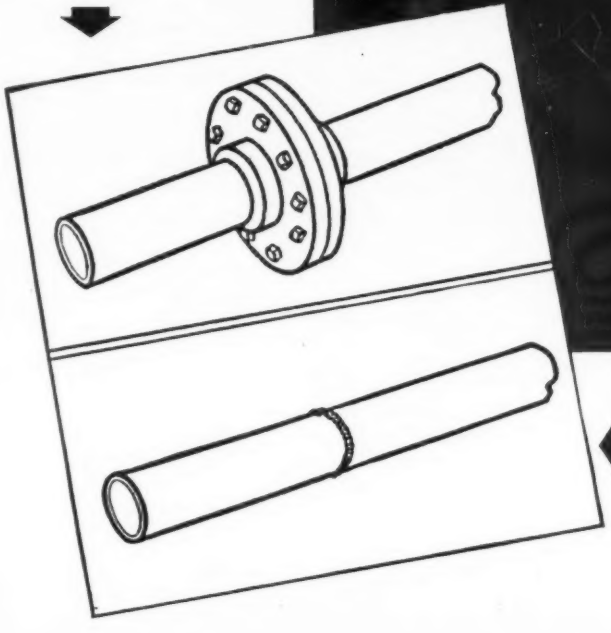
Be thankful for the hundreds of new concepts that are now overcoming our peril. For example:

"A New Map is Unrolling," *he says*

LOOK, MARSHAL SMUTS, how fundamental thinking is revising old concepts in the installation of piping:

THE OLD MAP

in the connection of a steam line. Requires threading of pipe ends, assembly with flanges, gasket and bolts. Is difficult to insulate. Joint requires maintenance.



THE NEW MAP

. . . the result of fundamental thinking with Arc Welding. Simply butt weld the pipe together with "Fleetweld" Electrode (mild steel). Joint is streamlined . . . easy to insulate, and it is permanently leak-proof. Arc welding of the 10" and 6" steam lines shown above saved an average of about 55% in joint cost over flange connections.

VALUABLE INFORMATION on pipe welding is given in the "Procedure Handbook of Arc Welding".

Price $1.50, C.O.D.

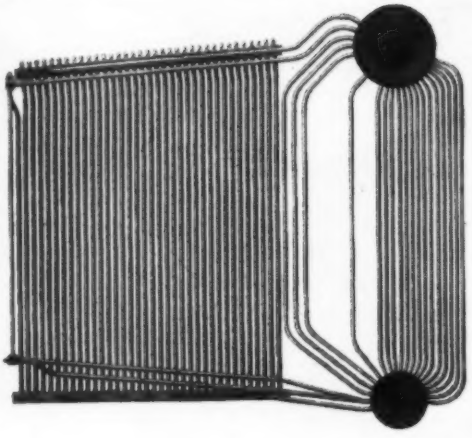
The Lincoln Engineer nearby will gladly help you revise old concepts with Arc Welding.

THE LINCOLN ELECTRIC COMPANY, CLEVELAND 1, OHIO

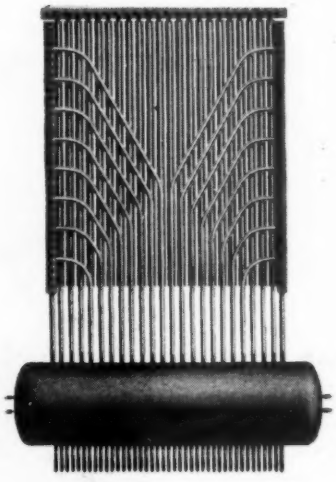
America's greatest natural **recourse**

ARC WELDING

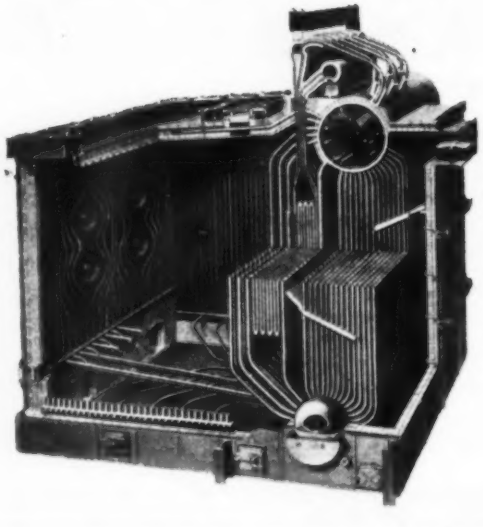
THESE 6 FEATURES ASSURE



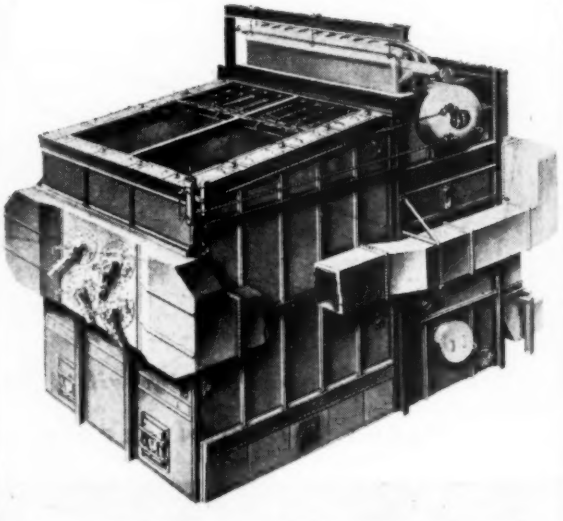
1. Symmetrical Design. Any longitudinal section through the unit is the same as any other. Each has the same amount of furnace volume, the same evaporative surface, the same superheating surface. Each functions under similarly uniform conditions — same mass flow of gases at practically the same temperatures at any given point. Thus each carries the same amount of water and produces the same amount of steam.



2. Quality Steam. All of the most active steam producing tubes enter the drum above the normal water line (refer to illustration at the right) and discharge uniformly across its full length as shown above. This arrangement reduces turbulence to a minimum and permits effective utilization of the entire steam release space. Dry steam and a stabilized water level are thus assured even under adverse conditions.

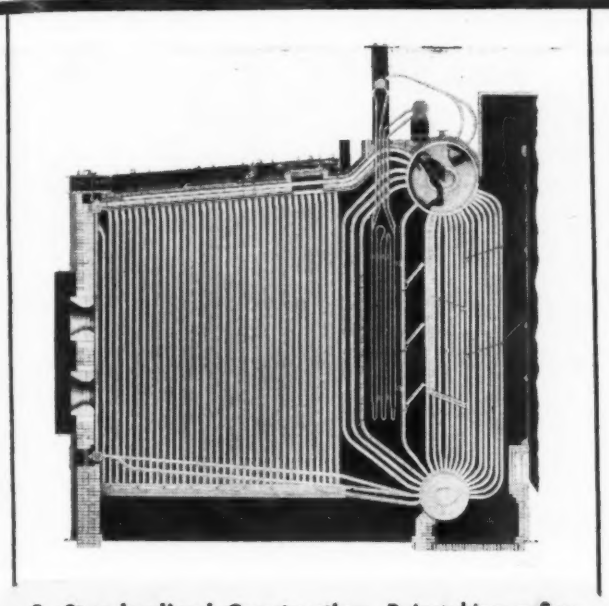


5. Adaptable in Application. The VU Unit may be fired by pulverized coal, oil, gas or any combination of these fuels. It is likewise readily adaptable to firing by any type of stoker. These units are suitable for widely varying requirements of load, pressure and temperature. Inclusion of an interbank or intertube superheater, an air heater or economizer is easily accomplished as conditions require.



6. Steel Encased Setting. The unit setting of shaped tile, refractory and 100% insulation are attractively finished by a permanent outer steel casing. This design, evolved from careful study and experiment, reduces to a minimum heat losses caused by radiation and air infiltration. It tends to eliminate hot spots and helps maintain a uniformly low surface temperature throughout the steel casing. Maintenance is negligible.

LOW COST STEAM



3. Standardized Construction. Painstaking refinement of detail is incorporated in each unit at a fraction of the original engineering cost. With standard parts and structural features, the merits of which are confirmed by experience, manufacturing and erection costs are materially reduced. First cost reflects the economy of standardized design and the buyer gains this benefit even before his VU Unit is placed in operation.

4. Overhead Suspension. Complete freedom of expansion in all directions is assured because all parts of the unit are suspended from the steel structure which provides the framework for the steel casing. This feature makes ample provision for the effects of temperature changes; it eliminates abnormal mechanical stresses on all pressure parts and explains to a large degree the freedom of the VU Unit from leaky joints.

THE design and structural features illustrated and described on these pages are to a large degree responsible for the efficient combustion, consistent production of dry steam at all ratings, high thermal efficiency, reliable operation and low steam costs which have characterized the operation of the many VU Steam Generating Units now in service.

To medium sized and smaller plants these features bring many of the advantages of C-E's experience with high capacity, high pressure units plus the benefits of standardization. The VU Steam Generating Unit has an extremely broad range of application. It has been installed for capacities from 30,000 to 300,000 lb of steam per hr and for virtually all conditions of pressure and temperature. There are many VU installations fired with pulverized coal, oil, gas and combinations of these fuels; also many with stokers.

Compare its features with those of any similar equipment on the market. Evaluate them point for point. Then you will see why the VU Unit is so widely regarded as the best steam generator of its type offered by any manufacturer. A-848

FIGHT INFANTILE PARALYSIS

COMBUSTION ENGINEERING

200 Madison Avenue New York 16, N. Y.

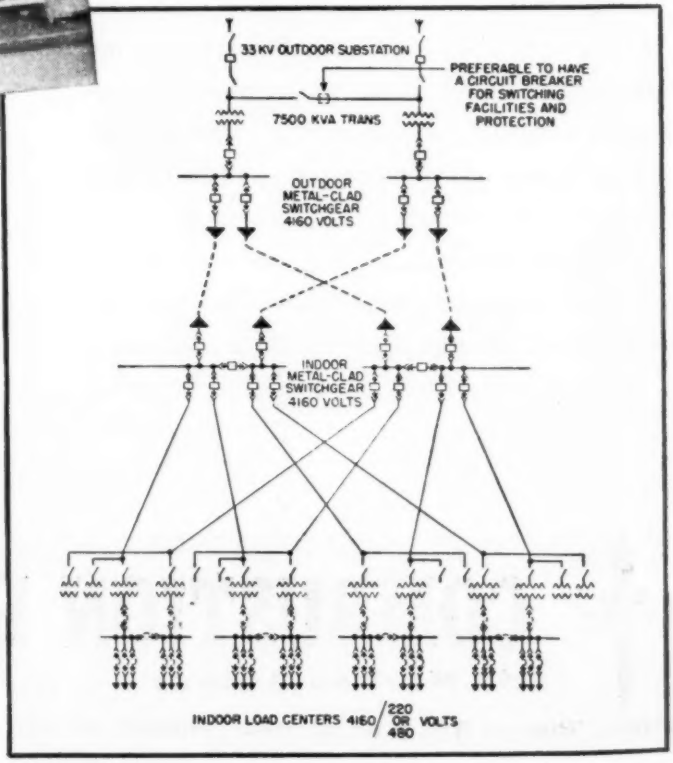
C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

NO "FREEZE" ON

Over the vast floor area of this windowless plant, power taps are close at hand for machines and lighting panels. Metal-enclosed bus runs come up from unit substations directly below in the basement.

A group of G-E load-center unit substations, showing high-voltage lines entering in interlocked-armor cable and the outgoing low-voltage metal-enclosed bus runs. Each load-center unit has two incoming lines.

"One-line diagram" of part of the power distribution circuit, showing the secondary-selective arrangement. Interconnection through sectionalizing breakers in the secondary provides an alternate supply in case of interruption in primary feeder or secondary transformer.


33 KV OUTDOOR SUBSTATION
PREFERABLE TO HAVE A CIRCUIT BREAKER FOR SWITCHING FACILITIES AND PROTECTION
7500 KVA TRANS
OUTDOOR METAL-CLAD SWITCHGEAR 4160 VOLTS
INDOOR METAL-CLAD SWITCHGEAR 4160 VOLTS
INDOOR LOAD CENTERS 4160/220 OR 480 VOLTS

LOAD-CENTER

Power Distribution Systems

MACHINE LOCATION

at a plant with a load-center power system

Output has stayed high in this aircraft-engine plant, in spite of work changeovers that require relocation of many machines. In one three-month period, more than 2000 machines were shifted, but these machines never stood idle for lack of electric energy.

Why was full-voltage power so quickly available for every machine, no matter where located? Why has the plant management such complete *freedom* in planning tomorrow's work flow and machine location?

First, because when the plant was built, *power flow was put on a par with production flow.*

Such advanced features of plant design as windowless, air-conditioned construction could be adopted without misgivings—because the secondary-selective distribution system gives unusual protection to power continuity. It helps make a plant-wide blackout virtually impossible.

Second, because *the distribution system is of the modern load-center type.*

Individual G-E unit substations are located in the basement, for the most part directly below the load areas they serve. Primary power is distributed to these units at 4160 volts, each load-center substation having two incoming lines. Secondary circuits, each with its individual breaker, consist of short, metal-enclosed bus runs, passing up through the floor and above the work area, with power taps of Flamenol† cable to the machines.

Third, because metal-clad switchgear and unit substations were selected for the job.

A transformer section using Pyranol*, which is non-burning, permits G-E unit substations to be installed without vaults wherever the loads require them. G-E switchgear assures *adequate* interrupting capacity. Increased loads requiring more transformer capacity can be supplied with additional easily installed units.

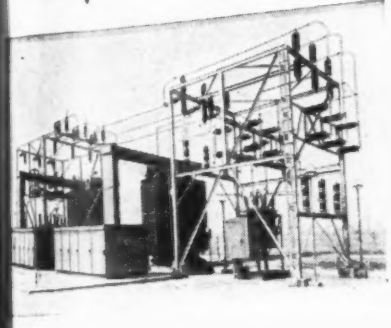
Before you settle on your plans for plant reconversion with respect to power supply, why not review the experience of plants that have adopted *load-center distribution?* G-E application engineers will be glad to give you facts and figures for immediate or postwar consideration. *General Electric Company, Schenectady 5, N. Y.*

†*Reg. U.S. Pat. Off.*

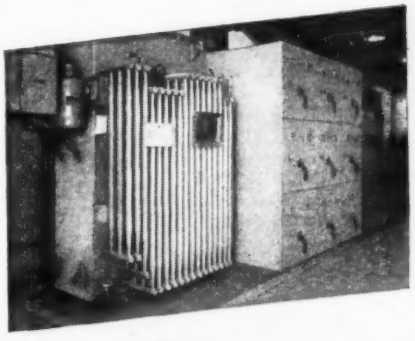
**Trade-mark for General Electric's nonsludging, insulating and cooling liquid that will not burn*

Write for this new booklet—"Load-center Unit Substations" (GEA-3592) gives valuable information on planning a fully modern power system, shows installation in many plants.

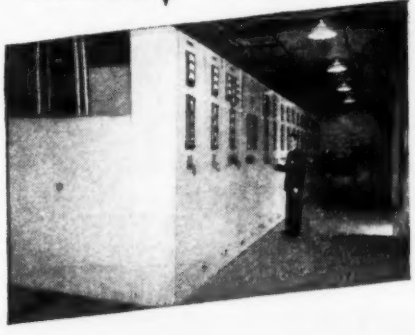
At this outdoor substation, two G-E 7500-kva transformers step down the 33-kv incoming energy to 4160 volts.



Close-up of G-E unit substation showing Pyranol transformer and metal-enclosed, drawout air circuit breakers.



Indoor vertical-lift metal-clad switchgear protects incoming lines and distribution feeders to the load centers.



GENERAL ELECTRIC

BUY WAR BONDS

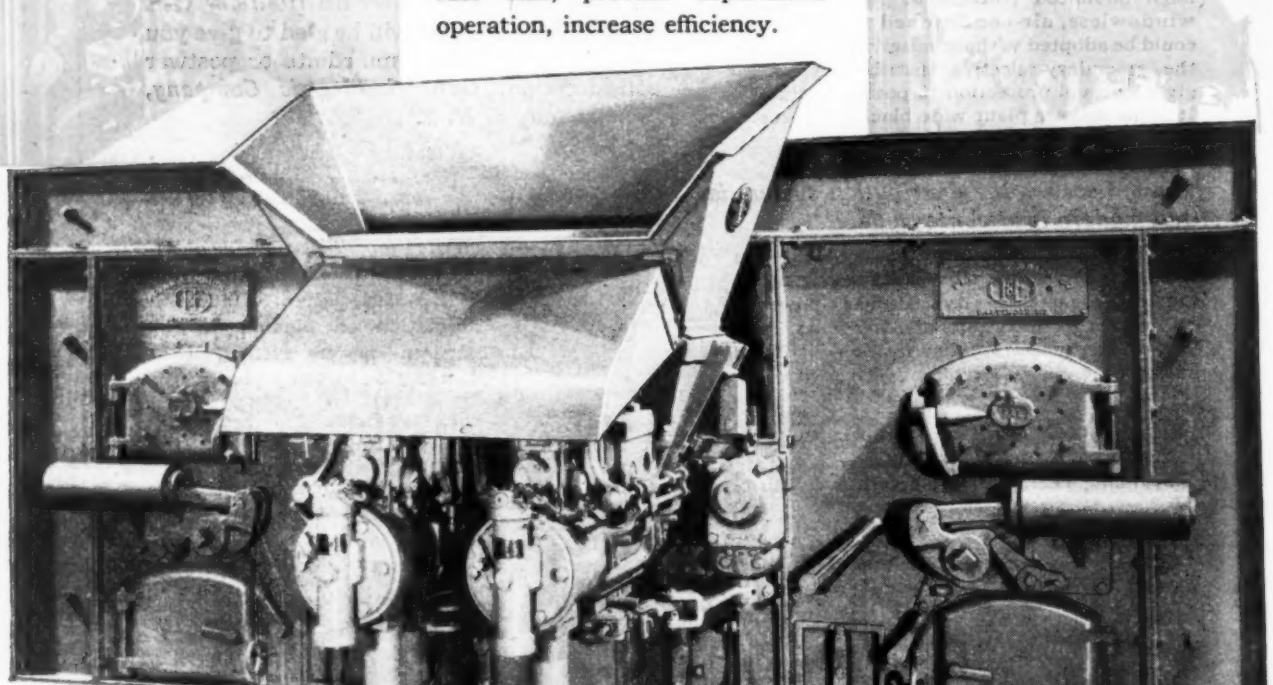
302-35

SERVING OVER 700,000 BOILER HORSEPOWER

"F & E" UNDERFEED STOKERS

There is an "F & E" Underfeed Stoker to meet your requirements—whether they be 1000 lbs. of steam per hour or 40,000!

See the "F & E" representative in your locality, your own consulting engineer or write manufacturer for information that tells WHY and HOW "F & E" Underfeed Stokers increase output of boilers, reduce fuel bills, provide dependable operation, increase efficiency.



THE ONLY STOKER
WITH THIS COMBINATION OF ENGINEERED FEATURES
1-Choice of Electro-Hydraulic or Steam Ram Drive; 2-Internal Timer Governor; 3-Sliding Bottom Retort; 4-Renewable Ram Case Liner; 5-Exterior Fuel Bed Adjuster; 6-High Efficiency Tuyeres

FLYNN & EMRICH CO.
Established 1842
HOLLIDAY & SARATOGA STREETS, BALTIMORE 2, MARYLAND
Representatives in Principal Cities

[PUMP TIPS FROM ALLIS-CHALMERS — ONE IN A SERIES]

How to make BEARINGS Last Longer . . .

ONE OF THE MAIN CAUSES of bearing trouble is misalignment. For when pump and its driving motor are not correctly aligned, every revolution of the shaft throws tremendous extra load on all moving parts within the pump's closely fitted body — resulting in greatly accelerated wear, oftentimes in complete bearing failure.

In an effort to eliminate the misalignment factor, A-C developed, for many applications, the "Electrifugal" pump — in which both motor and pump impeller are mounted on one shaft and in one frame. This *unit-design* prevents shaft from getting out of line . . . minimizes possibility of excessive bearing wear.

However, many pumps in use today are coupled to *separate* driving motors. In guarding against misalignment in this type pump, see that coupling flanges are perfectly aligned — and that they're kept that way!

Allis-Chalmers "Electrifugal" Pumps are equipped with two large ball bearings which support *both* the rotor and runner on one shaft.

Regardless of whether your pumps are equipped with ball, roller or sleeve bearings, here are a few maintenance tips that can prove useful to you in getting longer life out of bearings:

▶ Although too much oil won't harm sleeve bearings, too much grease in anti-friction type bearings will *promote* friction and heat. Main job of grease in anti-friction bearings is to protect steel elements against corrosion, not friction.

▶ No one rule on lubrication frequency fits all pump installations. So play safe: if anything, change lubricant *before* it's too worn or too dirty.

▶ Once a month, check bearing temperatures with a thermometer . . . *not by hand.*

▶ In the case of sleeve bearings, measure bearings for wear every three months, replacing them if wear is excessive. Generally allow two-thousandths of an inch clearance — plus one-thousandth of an inch for each inch of shaft journal diameter.

▶ Every three months, drain lubricant, washing out oil wells and bearings with kerosene. In the case of sleeve bearings, check to see that oil rings are free to turn with the shaft.

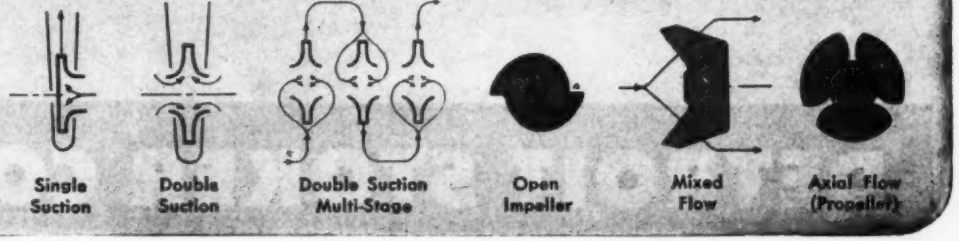
▶ If you haven't done so already, send for Allis-Chalmers' *free* "Handbook for Wartime Care of Centrifugal Pumps". Applies to *all* makes of pumps; contains *no* advertising. Contents include: valuable tables of friction losses; handy guide to locating trouble; wartime maintenance schedule. Address your request to ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WIS.

A 1709

♪ *Tune in the Boston Symphony, Blue Network, every Saturday at 8:30 pm, EWT.*

ALLIS-CHALMERS PUMPS

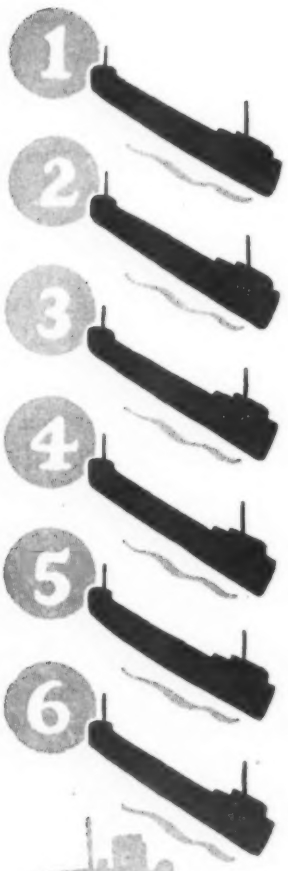
Allis-Chalmers builds all types and variations of pumps shown at right. Capacities from 10 to 150,000 gpm—heads to 2500 lbs.



DETROIT ON

Over three-fourths of all the turbine driven bulk freighters of the Great Lakes fleet use Detroit RotoStokers.

Many repeat orders by leading boat Operators. Reasons why Detroit RotoStokers are favored:



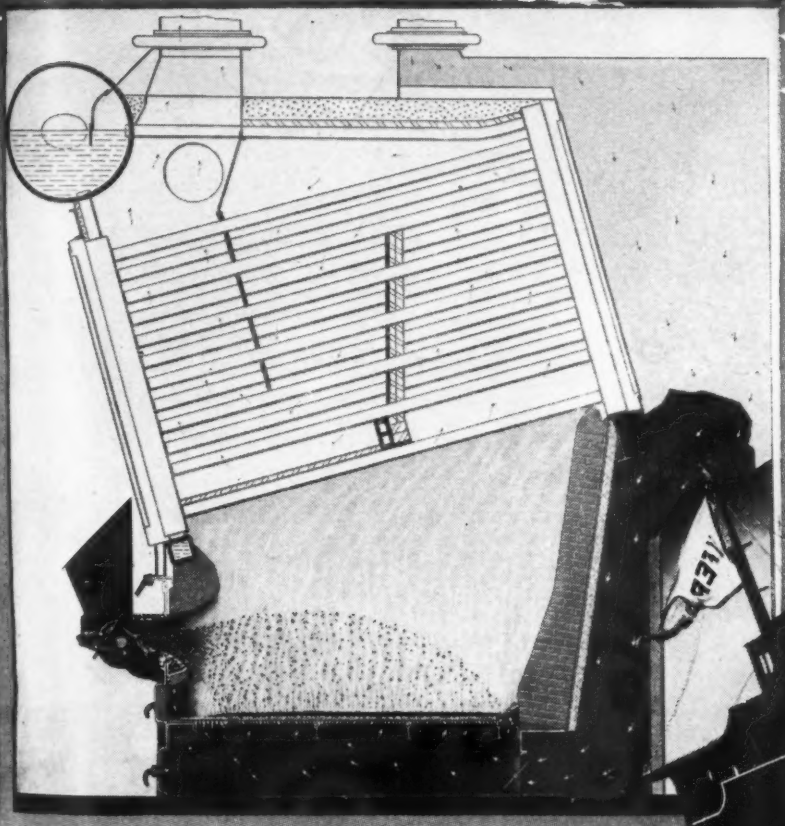
1. Successfully burn a wide range of coal.
2. Handle widely fluctuating loads maintain uniform steam pressure.
3. Permit high coal burning rates per square foot of grate area.
4. Banking losses are low, due to the extremely thin fuel bed.
5. Compact, simple design with no moving parts in the furnace.
6. Heavily built for years of continual service.

Detroit Stokers will increase the capacity and reduce the cost of operation. Write for Bulletin 830.

DETROIT STOKER COMPANY

THE GREAT LAKES

DETROIT ROTOSTOKERS ALSO SOLVE MARINE STEAM PRODUCTION PROBLEMS



Detroit RotoStoker (stationary grate type) applied to a cross drum boiler for marine application. Air for combustion may be preheated.

Fine particles of fuel are burned in suspension and the coarse coal on the grates. OVERTHROW ROTORS insures uniform fuel distribution.

GENERAL MOTORS BUILDING • DETROIT 2, MICHIGAN

Works at Monroe, Michigan • District Offices in Principal Cities • Built in Canada at London, Ontario

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The Texaco Star Theatre
with James Melton
Sunday Nights
★
Metropolitan Opera
Saturday Afternoons
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Symbol of

DEPENDABILITY

FOR OVER three-quarters of a century the 114-foot Minot's Ledge Light has stood, a symbol of dependability, guiding mariners through outer Boston Harbor.

Like the lighthouse, the Diesel has, by its outstanding performance, earned a similar reputation for dependability everywhere in the field of power generation. And wherever they are used . . . on land and sea, in stationary plants and mobile equipment . . . Diesels operate more efficiently, more dependably, when lubricated with Texaco Ursa Diesel lubricants.

Texaco Ursa Diesel lubricants constitute a complete line of Diesel lubricants. There is one to meet the lubrication requirements of every type of Diesel engine. They increase the life of rings, pistons, liners and bearings by preventing scuffing, ring-sticking, sludge and corrosion. Because of these benefits—

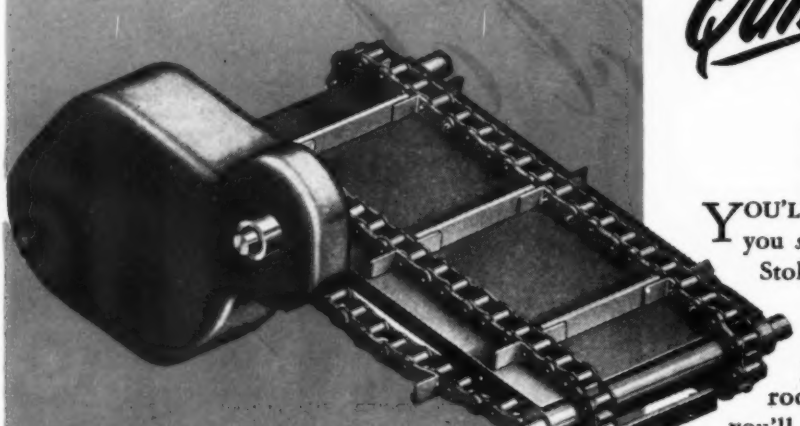
More stationary Diesel hp. in the U.S. is lubricated with Texaco than with any other brand.

A Texaco Lubrication Engineer, specializing in Diesel lubrication, will gladly recommend the most suitable type and grade of Texaco Ursa Diesel lubricant for your engine. Phone the nearest of more than 2300 Texaco distributing points in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO Lubricants and Fuels

FOR ALL DIESEL ENGINES



YOU CAN HAVE

Quiet Automatic Stoking

YOU'LL hardly believe your eyes or ears when you *see* and *hear* the new Æ Perfect Spread Stoker in operation. You'll see something entirely new and practical in stoker design. You'll see dependable, completely automatic stoking that ends boiler room drudgery and inefficient firing. And you'll be amazed at its *smooth,* unusually *quiet* operation.

You get maximum heat out of all kinds and grades of solid fuels, wet or dry, with the Æ Perfect Spread Stoker. Add to these economies the non-clogging feeder, overthrow spreading, "cross-firing" and other advantages, and you have a good idea how to produce more steam at lower cost.

Other thrifty features and reasons why you should consider this stoker *now* are described in the new Æ Perfect Spread Stoker bulletin. Write for it today.

ALL SPEED DRIVE GETS STEAM UP *FAST*

The Æ Perfect Spread Stoker answers steam demands instantly through a novel all-enclosed, adjustable-speed drive on the coal feeder. Automatic controls properly regulate the rate of feed and amount of forced draft to requirements—getting steam up *fast* and keeping it there!

If Your Steam Requirements Call for 175 H. P. up to 200,000 lbs. per hour—

YOU NEED THIS BULLETIN

Write us. 2400 Aramingo Ave., Philadelphia 25, Pa.

Æ PERFECT SPREAD STOKER

Other Æ Products: Æ-Taylor Stokers, Lo-Bed Bollers, Marine Deck Auxiliaries, Bole-Steam Field Power, Diamond Face Grinders

AMERICAN ENGINEERING COMPANY

PHILADELPHIA 25, PA.

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SAFEGUARD YOUR DECISION WITH INFORMATION *NOW*

IF YOU'RE PLANNING a new stoker installation, can you afford to make a decision without knowing *all* the latest facts about *all* types of fuel firing equipment? Do you know, for instance, that great improvements have recently been made in Taylor Stokers?

These are *basic* improvements in the tested Taylor Stoker principles of operation that have proved their value many times over during 39 years in hundreds of installations. Stoker design is now vastly simplified for more precise control of coal feed, combustion and ash discharge. Emphasis is placed on features that mean more economical, automatic operation for low cost steam generation under the widest variety of conditions.

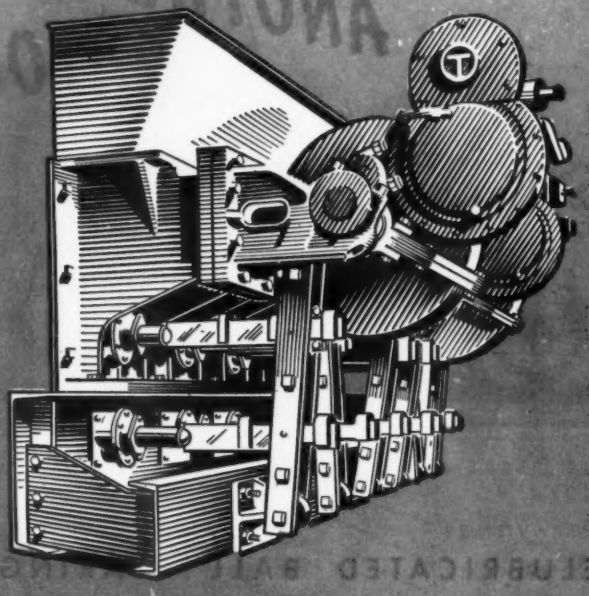
All the advantages of the Improved Type "R" Taylor Stoker are detailed in a new, highly informative booklet. Be sure to have the facts before you when you specify power plant equipment. Write for this booklet *today*.

IF YOUR Steam Requirements Call for 20,000 to 500,000 lbs. per hour—

YOU NEED THIS BOOKLET

Write us. 2400 Aramingo Ave., Philadelphia 25, Pa.

ANOTHER IMPROVEMENT IN THE TYPE "R" TAYLOR STOKER



MORE EFFICIENT FIRING WITH STRAIGHT LINE DRIVE

Complicated mechanisms are eliminated from the improved Taylor Stoker front end drive, which means easier, more efficient regulation of coal feed and fuel bed movement. Simplified straight line drive of coal rams and secondary pushers increases efficiency and "on line" time.

Æ TAYLOR STOKERS

AIR-COOLED & WATER-COOLED

Other Æ Products: Æ-Parker Spread Stoker, Lo-Boy Boiler, Marine Deck Auxiliaries, Rate-Shaw Fluid Power, Diamond Face Grinders

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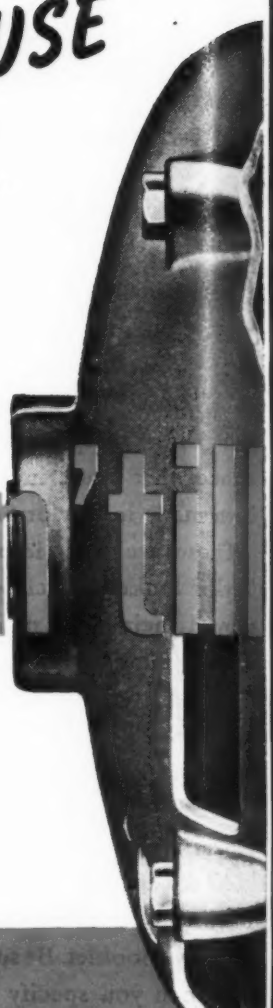
ANOTHER WESTINGHOUSE MOTOR "FIRST"

"No Lubrication" till



PRELUBRICATED BALL BEARINGS PRACTICALLY ELIMINATE BEARING MAINTENANCE...NOW STANDARD ON TYPE CSP MOTORS UP TO 3 HP

Twenty-two years ago Westinghouse was "first" with the "Sealed-Sleeve" Bearing that eliminated oil leakage, kept out dirt, and reduced maintenance on sleeve bearing motors. Today Westinghouse offers the first self-sealed, prelubricated ball bearing that eliminates lubrication for five years. Type CSP prelubricated motors bought now will need no lubrication until 1950.

Prelubricated bearings in Westinghouse motors have been thoroughly field-tested in thousands of Westinghouse lint-free textile motors. Recently a series of bearings was chosen at random and inspected from a group of 600 motors, the first of which were installed between six and seven years ago. All were in perfect condition—even though they had been in operation 24 hours a day and had never been lubricated.

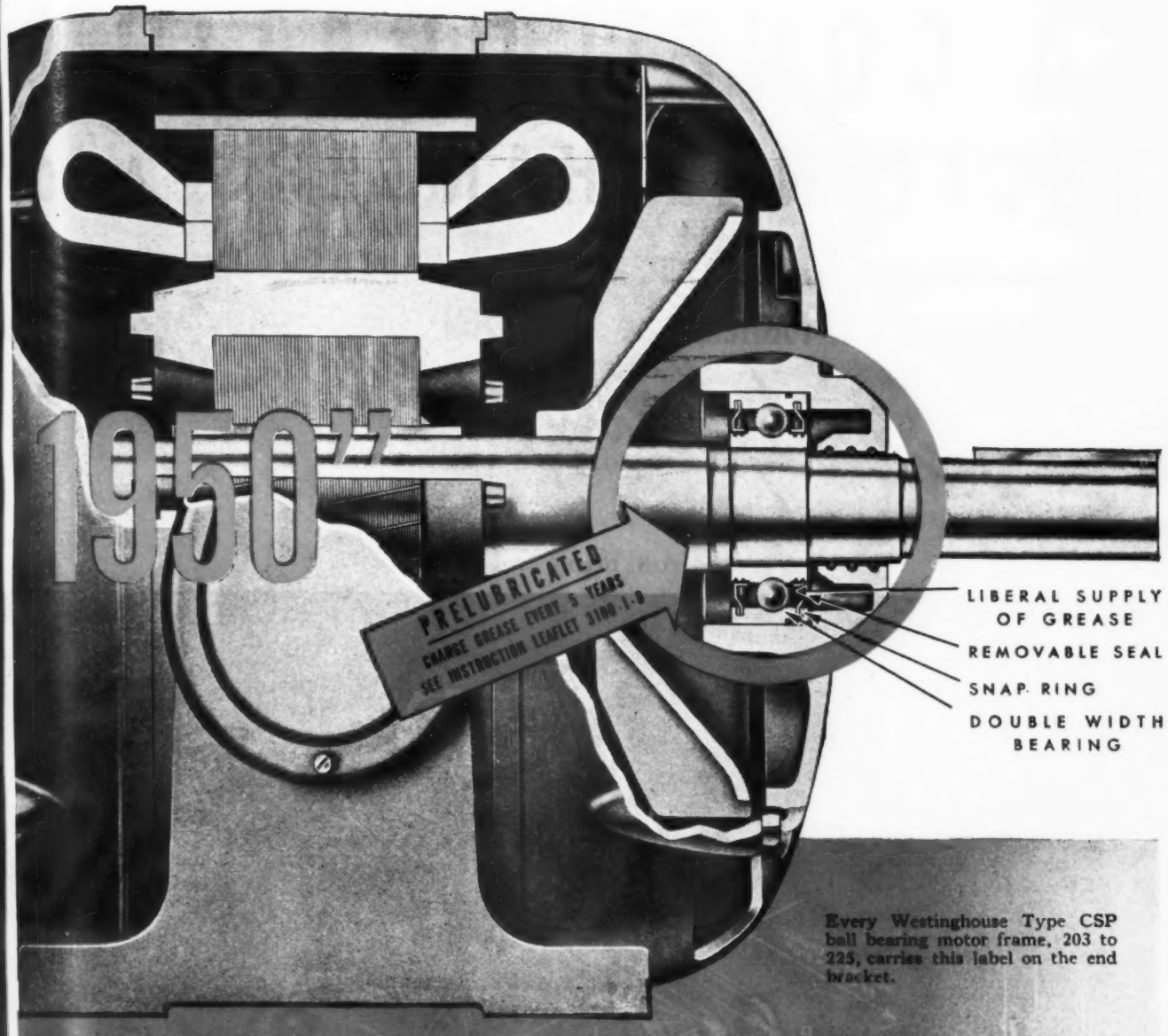
Time-tested special applications such as these have often paved the way for improvements in standard motors. Type CSP motors incorporate the fruits of wide Westinghouse motor application experience. When you buy a Westinghouse Type CSP motor, you get all the latest improvements. For complete information, write for DB 3100-CSP, Westinghouse Electric & Mfg. Co., P.O. Box 868, Pittsburgh 30, Pennsylvania. J-21318

ADVANTAGES

OF WESTINGHOUSE TYPE CSP MOTORS

- PRELUBRICATED SEALED BALL BEARINGS reduce lubrication maintenance ... assure longer grease life.
- IMPROVED TUFFERNELL INSULATION.
- DYNAMICALLY-BALANCED ROTOR.
- DIE-CAST ROTOR with oversize fan.
- LIBERAL THROUGH-VENTILATION—air enters front, leaves at drive-end of motor.

WESTINGHOUSE



Every Westinghouse Type CSP ball bearing motor frame, 203 to 225, carries this label on the end bracket.

Westinghouse

PRELUBRICATED SEALED BEARING CONSTRUCTION ...retains original grease packing within the stationary seal discs. Bearing chamber accommodates grease sufficient for more than five years of severe service. Held by snap rings, seal discs fit closely over inner race, forming an efficient seal. Snap rings and discs are easily removed to permit packing new grease in bearings.

TYPE CSP MOTORS

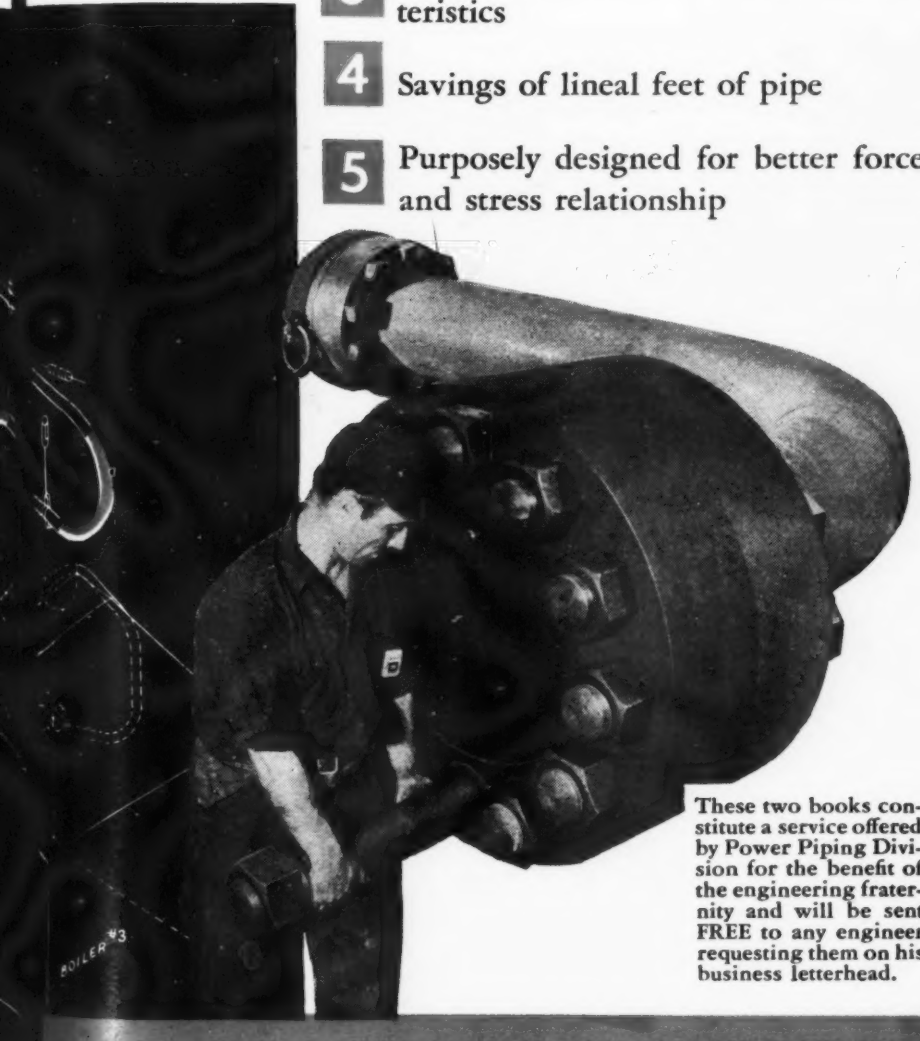
A CONFIGURATION
FUNCTIONAL HANGERS AND
Scientifically created

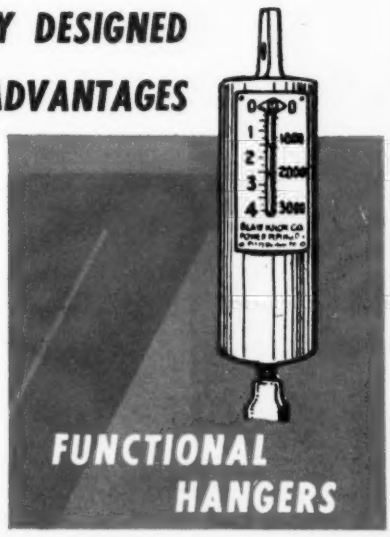
ENGINEERS . . .
PREFABRICATORS . . .
ERECTORS

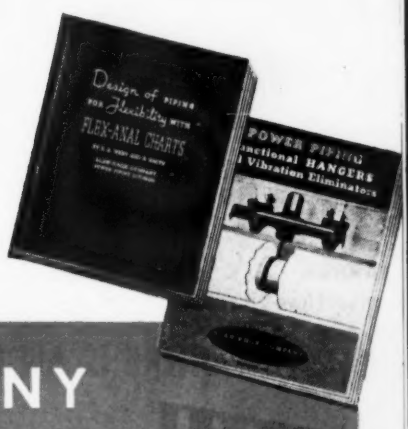
OF PIPE BENDS
VIBRATION ELIMINATORS

THIS SIMPLIFIED PIPING INSTALLATION IS SCIENTIFICALLY DESIGNED INCORPORATING PIPE BENDS: NOTE THESE FIVE DISTINCT ADVANTAGES

1. Reduction in number of joints
2. ★ Joints located in zone of lowest bending moment
3. More desirable steam flow characteristics
4. Savings of lineal feet of pipe
5. Purposely designed for better force and stress relationship







These two books constitute a service offered by Power Piping Division for the benefit of the engineering fraternity and will be sent FREE to any engineer requesting them on his business letterhead.

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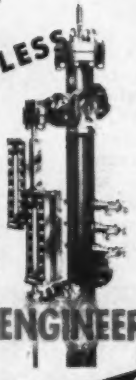
Yarway

SEATLESS

YARWAY
Seatless Blow-Off Valve

FLOATLESS



YARWAY
Floatless Hi-Lo Alarm Water Column

REMOTE

YARWAY
Remote Liquid Level Indicator

GUN-PAKT

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IMPULSE

YARWAY
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"THERE IS AN ENGINEERING REASON" FOR EVERY YARWAY PRODUCT

YARWAY

makes a movie...

Lights . . . action . . . sound . . . camera!

Yarway has made a new 16 mm. color film on "*the engineering reasons*" behind familiar Yarway steam plant equipment. It is now released for showing throughout the country.

FACTUAL! This film is full of reasons why Yarway products have won universal approval from steam engineers; reasons why they will give dependable, trouble-free service in your plant, too.

FAST-MOVING! From James Watt's bobbing tea kettle lid which opens the film, to the final Parade of Yarway-Engineered Products, every foot is action-packed.

COLORFUL! Filmed in life-like Kodachrome to give clarity and realism throughout.

HELPFUL! Every steam user will find the scenes on product maintenance and industrial applications especially valuable.

LOWELL THOMAS COMMENTARY! The world-renowned Lowell Thomas adds crisp, accurate narration throughout.

NOW AVAILABLE! Prints are now available without cost for showing before technical societies, plant engineer groups, engineering schools and other organizations. Write on company or organization letterhead for full information today.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Phila. 18, Pa.

STEAM PLANT EQUIPMENT

12 EASY METHODS OF IMPROVING VOLTAGE ON YOUR PLANT CIRCUITS

HOW TO CORRECT LOW VOLTAGE

Feeder Voltage Condition	Circuit Loading	Power Factor	Correct by means of	See Fig.
Low	Normal	Good	Transformer tap setting	1
			Voltage regulator	2
			Autotransformer	3
High feeder drop	Normal	Good	Voltage regulator	2
			Parallel circuit	4
			Autotransformer	3
High feeder drop	Normal	Low	Shunt capacitors	5
			Voltage regulator	2
High feeder drop	Overload	Low	Shunt capacitors	5
			Shunt capacitor and voltage regulator	6

HOW TO CORRECT HIGH VOLTAGE

Normal drop	Normal	.....	Voltage regulator	2
			Transformer tap setting	1
Normal drop	No load	.....	Voltage regulator	2
			Transformer tap setting	1
Voltage rise	"No load" (except shunt capacitors are on)	Leading at no load	Automatic switching of capacitors	7
			Voltage regulator (if no penalty clause for leading power factor)	6

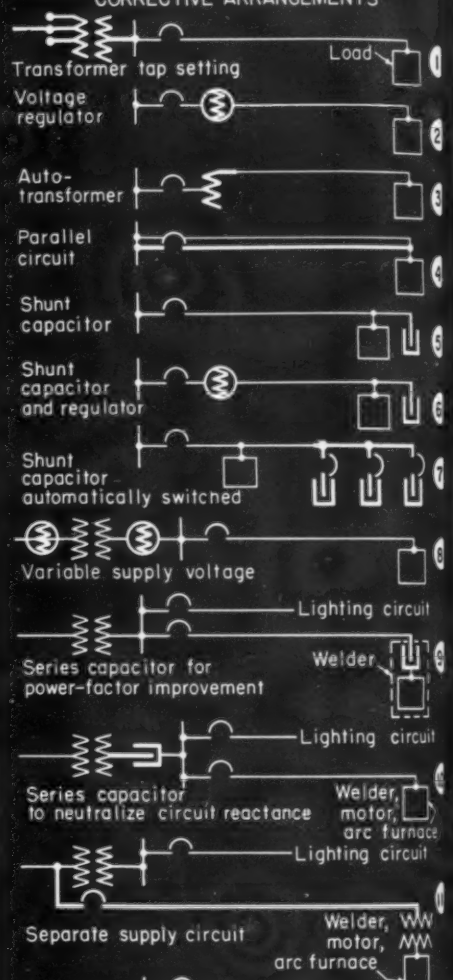
HOW TO CORRECT VARIABLE SUPPLY VOLTAGE

(Voltage regulator is only practical solution) 8

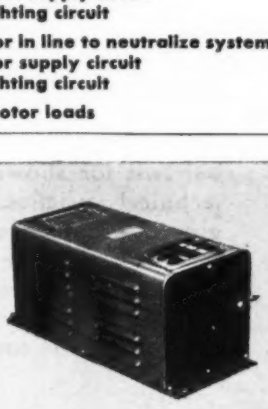
HOW TO CORRECT LIGHTING FLICKER

Load Causing Flicker	Correct by means of	See Fig.
Resistance welders, spot or seam	Series capacitor with welder to reduce demand by power-factor correction	9
	Series capacitor in line to neutralize system reactance	10
	Separate welder supply circuit	11
	M-g set for lighting circuit	12
Flash and resistance welders	Separate welder supply circuit	11
	M-g set for lighting circuit	12
Motor loads, such as: sawmills, rubber mills, grinders	Series capacitor in line to neutralize system reactance	10
	Separate motor supply circuit	11
	M-g set for lighting circuit	12
Arc furnaces	Same as for motor loads	

SCHEMATIC DIAGRAMS OF CORRECTIVE ARRANGEMENTS

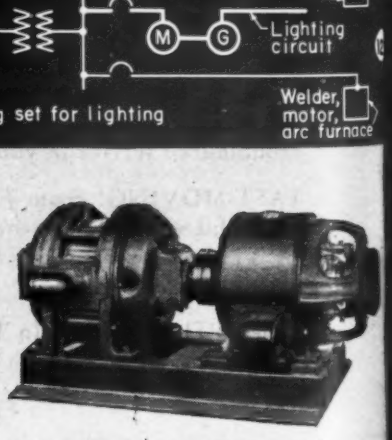


THE RIGHT VOLTAGE AT THE RIGHT PLACE DOES THE JOB **BETTER**



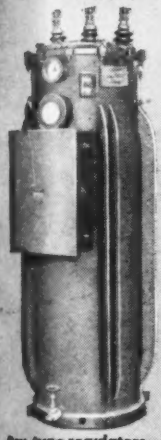
***Voltage stabilizers*—Automatically provide a constant 115-volt supply to a given load on circuits varying from 95 to 130 volts. Ratings from 50 to 5000 va. Ideal for precision laboratory or manufacturing processes. Ask for Leaflet GEA-3634.**

***Variable-voltage autotransformer*—Provides smooth, adjustable control of voltage, current, light, temperature, power, and speed at a turn of the dial. Ratings from 243 to 810 va. Ideal for use in factory and laboratory. Described in Leaflet GEA-3635.**



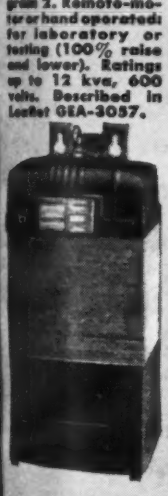
***Motor-generator sets*—Change a-c to d-c. Provide an inexpensive way to supply your lighting circuits independent of your power circuits to avoid lighting flicker. See diagrams 11 and 12. Described in Leaflet GEA-1945 (synchronous type); Leaflet GEA-394 (induction type).**

FOR SUCH CIRCUITS WE RECOMMEND THESE AIDS TO BETTER VOLTAGE



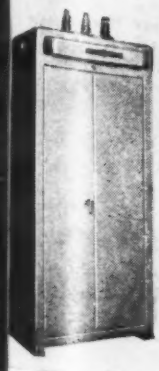
Pyranol or oil-filled regulators—Ideal for regulating variable line voltage (see diagram 8), or voltage on plant feeders. Provide 10% regulation raise and lower; automatic operation; 12 to 120 kva, 2400 to 6900 volts. Described in Leaflets GEA-3443 (Pyranol), GEA-2018 (oil, 24 kva and smaller), GEA-2985 (oil, 34.5 kva and larger).

Dry-type regulators—Automatic type: Provide 10% regulation raise and lower on circuits such as diagram 2. Remote-motor or hand operated: for laboratory or testing (100% raise and lower). Ratings up to 12 kva, 600 volts. Described in Leaflet GEA-3057.



Dry-type transformers and autotransformers—For insulating lighting circuits, reducing light flicker, boosting or stepping down voltage, and phase changing. See diagram 3. Ratings up to 100 kva, 600 volts. Ask for Leaflet GEA-897.

Pyranol capacitors (series or shunt type)—For reducing kva demand, improving power factor, increasing circuit loadability on such circuits as shown in diagrams 5, 6, 9, 10. Described in Leaflet GEA-2742 for circuits 575 volts and below; Leaflet GEA-2860 for circuits 2400 to 13,800 volts.



"Auto-switch" capacitors—For application on high-voltage side of step-down transformers. Units are automatically connected or disconnected with rise or fall of voltage or current. Ideal for improving power factor at heavy load without causing overvoltage at light loads, thus reducing burnouts and replacement of lamps, coils, etc. Detailed information on request.

They will help you gain some or all of these benefits

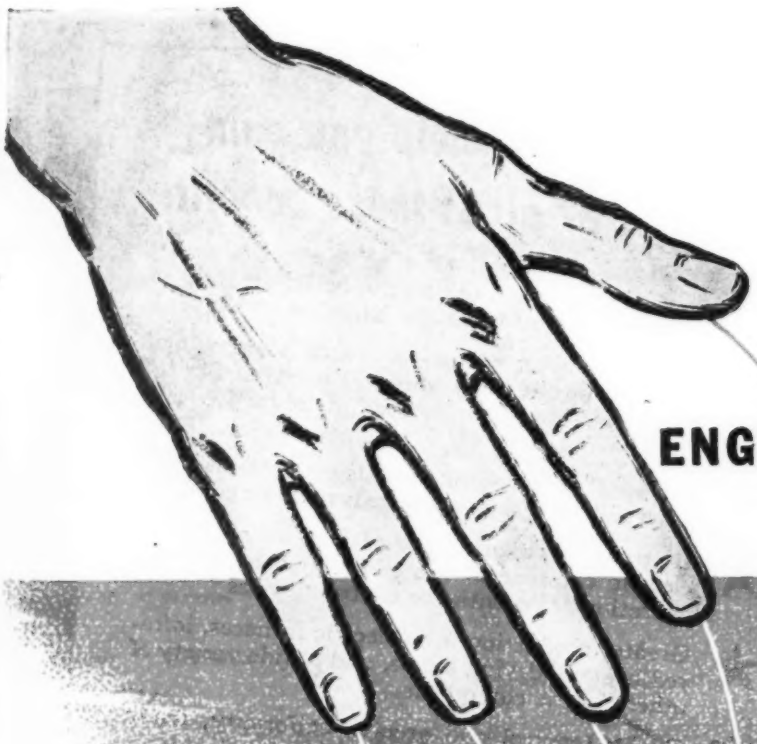
- Improved lighting (higher levels and the reduction or elimination of flicker); better starting of fluorescent lighting; longer lamp life
- Increased motor efficiency; greater starting and running torque and speed; the reduction of motor heating and, hence, maintenance and machine outages
- Reduced breakage and spoilage in textile and other mills where motor speeds must be constant
- Better performance and greater reliability of electric equipment; the elimination of sluggish operation of potential or control devices
- Greater production from electric furnaces, infra-red heaters, drying lamps, and a wide variety of other electric equipment
- Quality control and greater uniformity, fewer rejects, more accurate test results
- Temperature control on heating circuits
- Longer life of electric equipment; a reduction of overheating and burnouts; the protection of precision tools, electronic tubes, and delicate instruments
- Kva demand reduced, power factor improved, increased circuit loadability and, often, reduced power cost

GOOD voltage is no longer a luxury. It is now easy and inexpensive to extend the benefits of good voltage to every nook and corner of your plant—benefits that quickly pay for the small initial cost of equipment.

By good voltage we mean voltage that is neither too high, nor too low, nor extremely variable. A 10 per-cent *overvoltage* reduces incandescent-lamp life 75 per cent, decreases the power factor of general-purpose motors from 3 points at full load to 5 and 6 points at half load, and causes overheating in various potential devices. A 10 per-cent *undervoltage* decreases the light output of incandescent lamps approximately 30 per cent, increases the temperature rise of general-purpose motors 6 to 7 degrees C, reduces their torque and overload capacity approximately 19 per cent, cuts the output of a typical heating oven from 1500 to 1275 pounds per hour. Studies of the effect of poor voltage on other electric equipment show similar losses.

If you suspect poor voltage of being the cause of pepless motors, poor lighting, or production slumps at your plant, we'll be glad to help you make a system study. This will determine what corrective measures are necessary. Remember that whether you need voltage regulation for your plant as a whole, for your laboratory, for a vacuum tube, or a power shovel there is a simple, economical G-E device for the job. *General Electric, Schenectady 5, N. Y.*

GENERAL ELECTRIC



AT YOUR .

ENGINEERED ANSWERS TO E

FOR maximum production . . . top efficiency . . . lowest operating cost, give your machines the finest in lubricants—Tycol oils and greases. Tycol lubricants are made to meet every lubrication need of industry — from roll neck greases for steel mills to spindle oils for textile plants. Each Tycol lubricant is scientifically engineered to meet specific service conditions. At every step from selection of crudes to blending of the finished product, Tycol lubricants are processed to provide maximum lubricating efficiency which means greater economy, longer machine life for every type of equipment.

Tide Water engineers are thoroughly experienced in all phases of industrial lubrication. They will be glad to assist you in selecting the Tycol lubricant best suited to your specific need. Call or write your nearest Tide Water Associated office for further details.

TIDE WATER ASSOCIATED OIL COMPANY

MAKERS OF THE FAMOUS VEEDOL MOTOR OIL • Eastern Division: 17 Battery Place, New York 4, N. Y.
Principal Branch Offices: Boston, Philadelphia, Pittsburgh, Charlotte, N. C.

DRUMS! DRUMS! DRUMS!

War needs make it extremely important that all empty drums be returned immediately

Have You Received Your Copy of "Lubricania"?

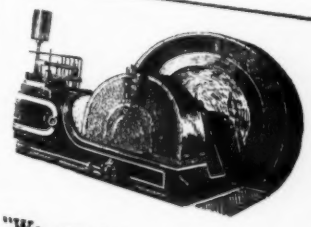
This informative handbook, "Tide Water Associated Lubricania", gives clear, concise descriptions of the basic tests used to determine important lubricant properties — Viscosity, Pour Points, Neutralization Number and many others. For your free copy write to Tide Water Associated Oil Company, 17 Battery Place, New York 4, N. Y.

TYCOL

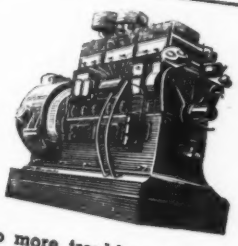
SCIENTIFICALLY

. . . Fingertips

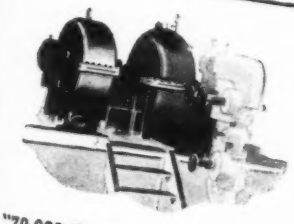
EVERY LUBRICATION NEED



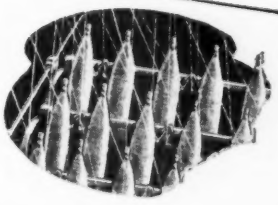
"We saved 33⅓% in oil costs when we changed to Tide Water E. A. Cylinder Oil." That report from a plant engineer typifies the kind of economical, trouble-free lubrication provided by Tide Water Steam Cylinder Oil in hundreds of plants. It gives better protection, promotes efficient operation and lowers lubrication costs.



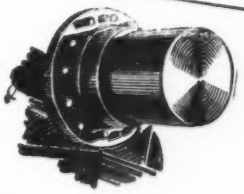
"No more trouble with sticking valves . . . costly delays and overhauls eliminated . . . engines giving better service . . ." — that's how one plant engineer describes the improved results gained with Tide Water Diesel Oil. It assures maximum economy — top performance — from every gallon of lubricant.



"70,000 Hours continuous operation . . . neutralization only .09." That's typical of the unusual performance achieved with Tycol Turbine Oil. Thanks to Tide Water's Edeleanu process, this oil has greater stability and resistance to emulsification . . . assuring more economy, steadier operation, smoother performance.



"300,000 Spindles operating for 13 years without a single lost tube" — that's a textile mill operator's way of pointing out the superior performance of Tycol Spindle Oils. For every textile application — from power plant to finishing — there's a Tycol Lubricant scientifically engineered for the job.



"Never a single bearing overheated since we changed to Tide Water Green Cast Grease," says one chief engineer. No matter how severe the service, Tide Water Green Cast Greases assure better lubrication . . . less maintenance. The reason? They contain more high-grade cylinder oil — less soap — which means better performance in every application.

INDUSTRIAL TYCOL OILS-GREASES

INDUSTRIAL LUBRICANTS

ENGINEERED FOR EVERY INDUSTRIAL USE

It couldn't possibly happen

BUT THERE WAS GRAVY IN THE BOILER WATER

You might call it the Great Foam Mystery, for in spite of the most careful treatment, boilers in a certain great industrial plant would suddenly start to foam.

To Hall engineers that meant that the water must somehow have become contaminated. Tests of the boiler water showed reactions that could not have been normally produced.

A check of all piping was made by the Hall engineer. At first this check was without result, but finally a check on a day when trouble occurred showed contamination in a condensate section which had at first been given a clean bill of health. From that point, the trail led to one of the plant cafeterias.

The sketch shows what was happening—how a situation that couldn't possibly exist was causing trouble in the boiler room—a valve turned off —a vacuum in the steam jacket—gravy in the warming kettle sucked up into the jacket and returned to the boilers—then foaming. There *had* been a series of inexplicable losses of gravy, sauces, soup and pudding in the past and the dates of these losses coincided with the dates of trouble in the boiler room.

Of course, contamination from such a source is rare, but the point of the story is that Hall service and Hall responsibility go far beyond prescribing chemicals to be added to the boiler water.

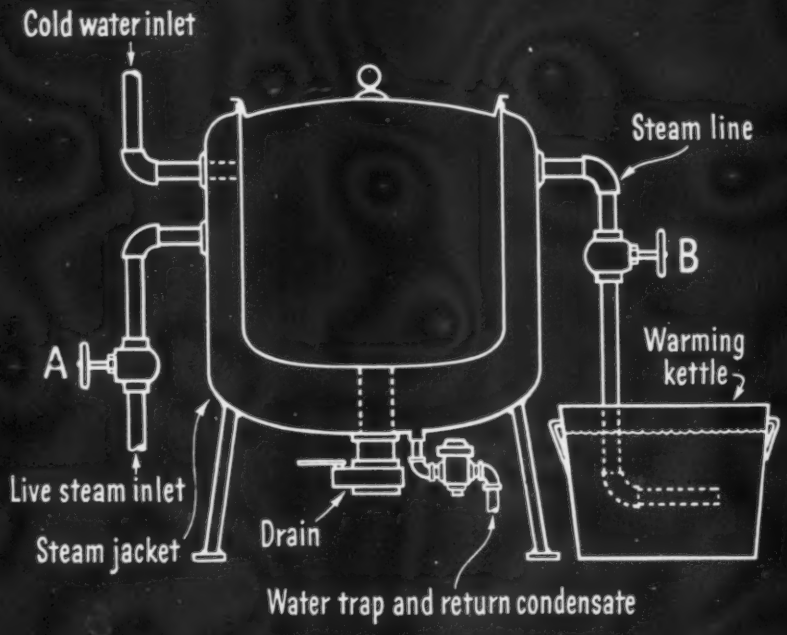
Hall service engineers check *all factors involved in boiler performance* and, in the event of trouble, trace that trouble down to its source.

Every plant that generates its own steam power can profitably use Hall service. Write us for full information.

HAGAN
HALL
BUROMIN
CALGON

HALL SYSTEM of Bo

HALL LABORATORIES, INC., HAGAN BUILDING, PITTSBURGH 30, PA.



HERE'S WHAT HALL CLIENTS GET:

1.

2.

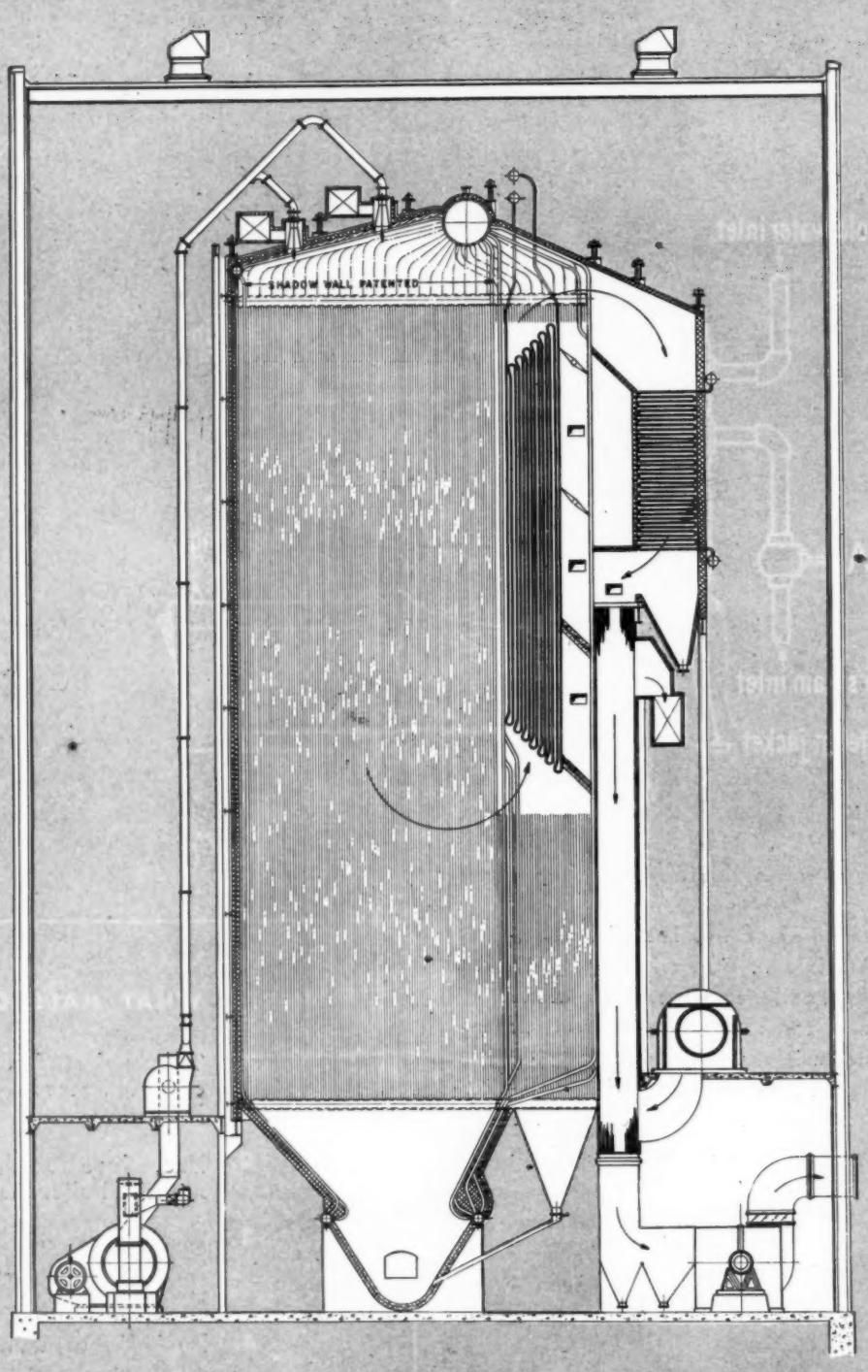
3.

4.

5.

6.

f Boiler Water Conditioning



KVS Steam Generating Equipment

BOILERS • AIR-SWEPT TUBE MILL PULVERIZERS • AIR PREHEATERS
SUPERHEATERS • ECONOMIZERS • WATER WALLS • COAL ELEVATORS
BUNKERS • COAL-WEIGHING SCALES • ASH CONVEYORS • FANS

KVS DESIGN

— MEETS THE NEED for LOW STEAM COST with AVAILABLE COALS

AN outstanding Kennedy Van Saun development in steam generators is the radiant design shown here . . . a complete unit which permits latitude in proportioning to adapt it for use with available, non-premium coals, including those having low-fusion characteristics as well as anthracite coal.

This boiler, together with its components, assures a means of steam generation which is high in efficiency and low in maintenance. Features include:

. . . an exclusive KVS Shadow Wall
. . . top firing under exact control
. . . effective and advantageous location of superheater with superheat control
. . . conveniently located economizer
. . . unit firing with KVS Integral Drive Tube Mill which assures proper preparation of any of a wide range of coals selected for plant operation.

• KVS is prepared to design and furnish complete steam generating units of this type for any pressure, temperature or capacity, and for operation on any coal. The completeness of KVS service assures one responsibility for the plant from design until turned over to the owner for operation.

Kennedy-Van Saun
MANUFACTURING AND ENGINEERING CORPORATION

2 PARK AVENUE • NEW YORK 16, N. Y.
FACTORIES: DANVILLE, PA.
CANADA • ENGLAND • AUSTRALIA

"Our IRON FIREMAN

save 20% in coal, 30%

—estimates J. R. Burke, maintenance foreman, Pittsburg

PITTSBURGH PLANT MODERNIZES BOILER ROOM

IN the summer of 1940 the Pittsburgh Equitable Meter Co., the world's largest manufacturer of water and gas meters, completely modernized its boiler plant. Due to the growth of company business, the old boiler plant was inefficient and inadequate to meet steam requirements, even in the handling of rated capacity. They wanted an efficient boiler room installation that would hold labor to a minimum, dispose of combustible refuse, and have a low maintenance cost.

To meet these requirements the company decided to install two Pacific No. 75-S-1 boilers having 2,143 square feet of heating surface and an E. D. R. rating of 36,431 square feet. The boilers are stokered with two Iron Fireman Poweram stokers of 1,600 pounds hourly coal burning capacity.

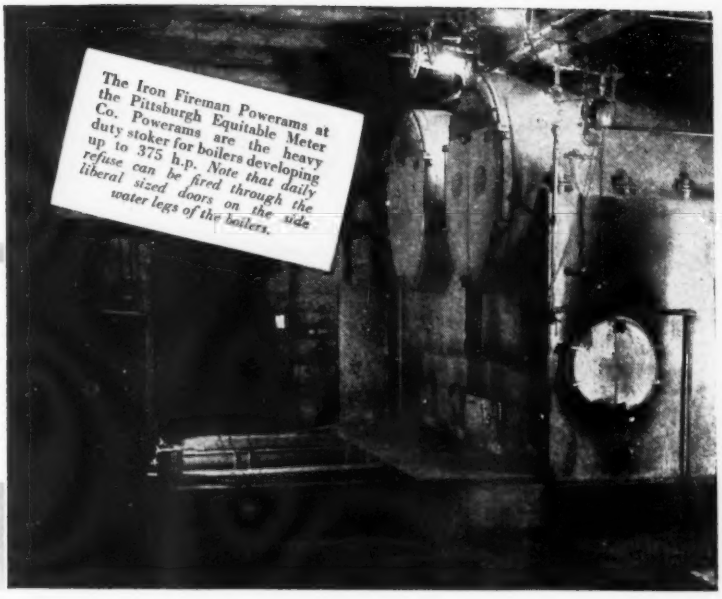
The Iron Fireman exclusive volumeter is highly responsive. Regardless of fuel bed conditions or the type of coal used, the Volumeter will always give the volume of air required.

The Iron Fireman stokers are equipped with motor driven forced draft fans. The forced draft air duct is equipped with a volumeter that meters the air for combustion in proper volume for the fuel burning rate. Variations in fuel bed resistance are automatically compensated for with no deficiency or excess of air, thus making possible high combustion efficiency.

STOKERS

%in labor"

...quitable Meter Company



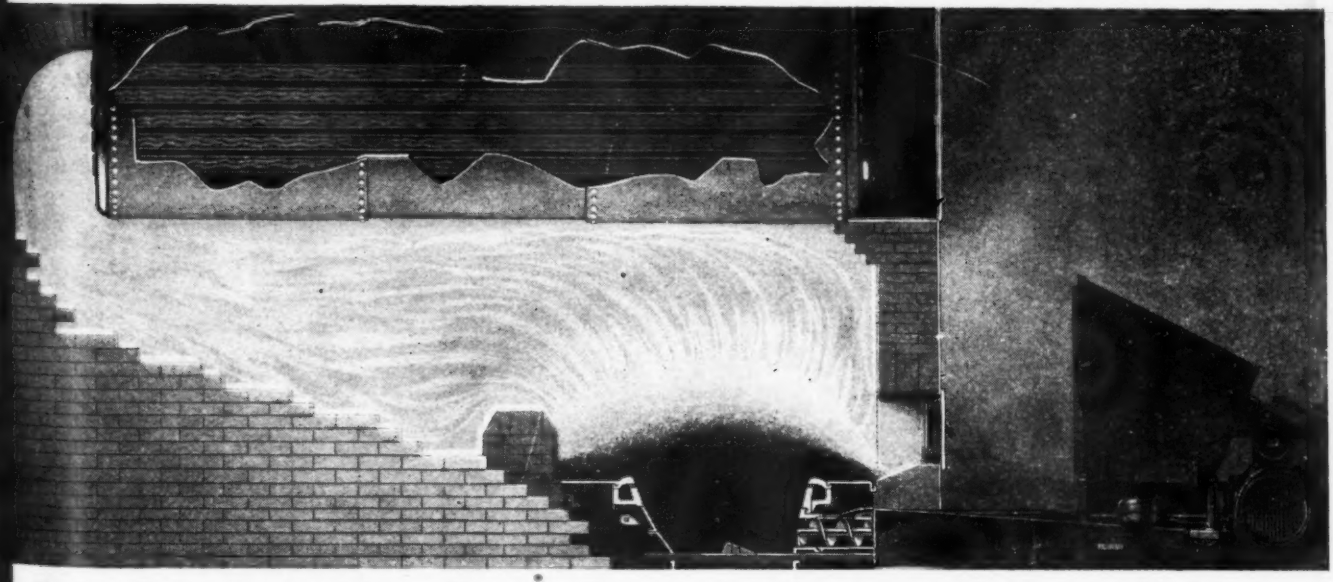
The Iron Fireman Powerams at the Pittsburgh Equitable Meter Co. Powerams are the heavy duty stoker for boilers developing up to 375 h.p. Note that daily refuse can be fired through the liberal sized doors on the side water legs of the boilers.

THE high combustion efficiency of the Iron Fireman stokers is responsible for a fuel saving of 20% over hand-firing at this plant. The Iron Fireman Poweram stokers installed here are of an extended design with a distance of 16 feet from the center line of the retort to the center line of the coal hopper. The extended design was selected so the coal hoppers could be filled directly from the coal bin, thus avoiding the wheeling of coal from the bin to hoppers located at the boiler front. This design helped to make the 30% reduction in labor.

The extended arrangement keeps the boiler room clean. There is no wheeling of coal, piling of it in front of boilers or shoveling.

Iron Fireman Stokers Available

Iron Fireman commercial and industrial stokers are in full wartime production. Our nationwide organization of qualified engineers and dealers will make a free survey to determine what Iron Fireman can do for you. Write the Iron Fireman Manufacturing Company, 3841 West 106th Street, Cleveland 11, Ohio.



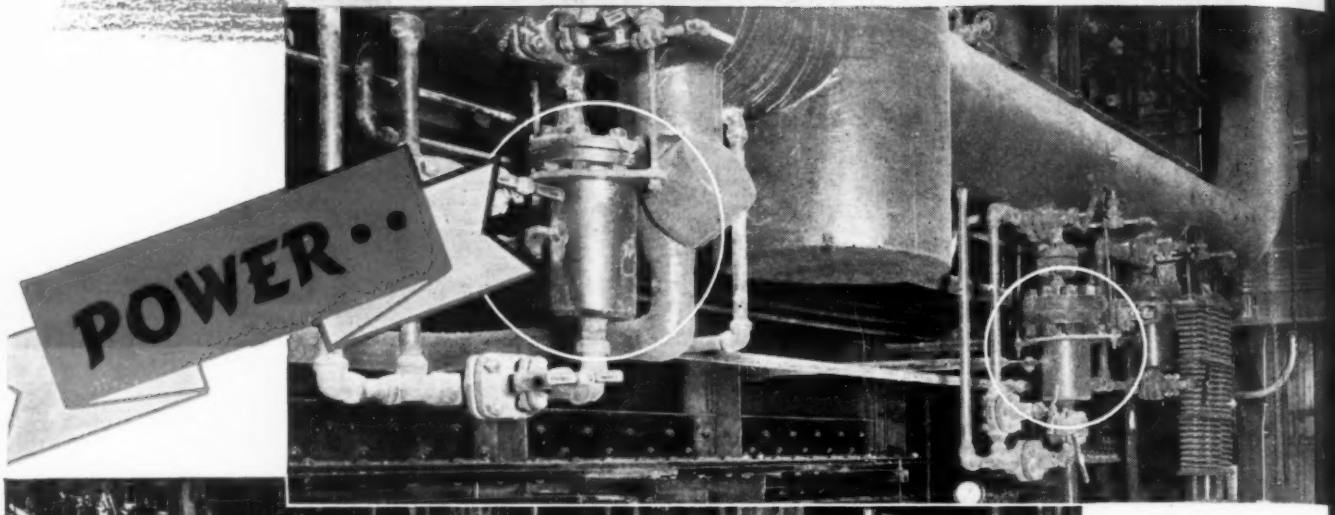
The Iron Fireman Poweram design combines non-packing screw-conveying with reciprocating retort distribution. The reciprocating blocks in the bottom of the retort eject fuel from the retort and properly distribute it over the burning area of the stoker. The Iron Fireman slowly preheats the coal, bringing it up to the ignition temperature as it nears the top of the fuel bed. An Iron Fireman fired boiler is never choked with coal, nor is the fire allowed to unduly die down. Automatic controls insure the fuel supply necessary for current steam demands.

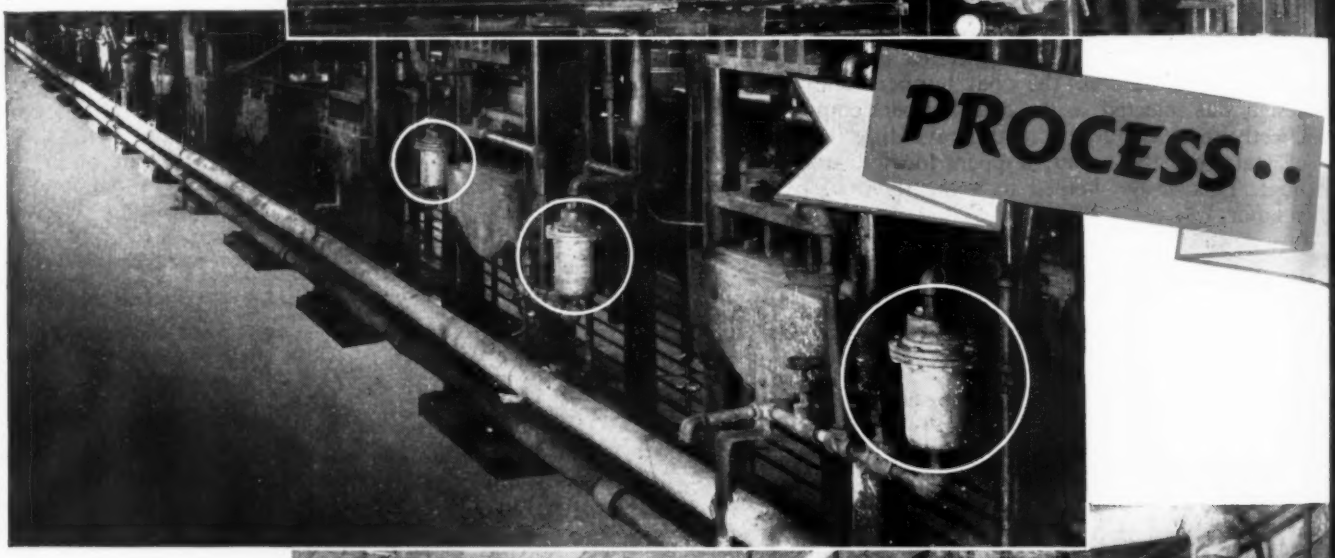
IRON FIREMAN

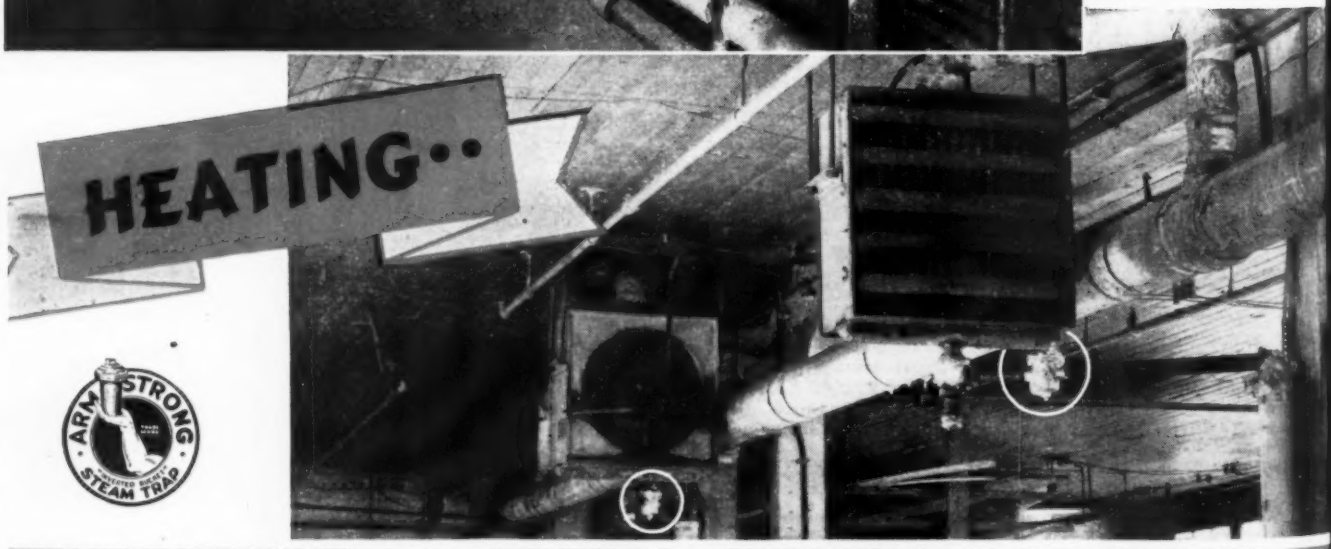
THE IRON FIREMAN

Automatic Coal Stokers

SOME AIDS TO THE S







ARMSTRONG STEAM TRAP

ARMSTRONG *Inverted Bucket*

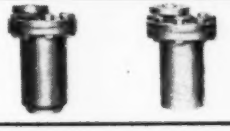
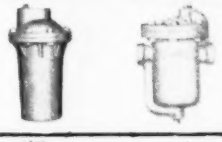
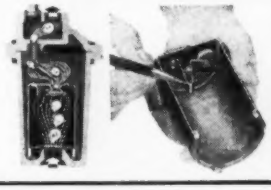
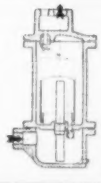
Selection of STEAM TRAPS

In planning the installation of steam traps, it is desirable to have in mind the types of traps available for various services. The chart below, describing briefly the Armstrong Traps available to meet practically any condensate requirements, will serve as a guide.

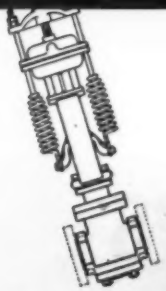
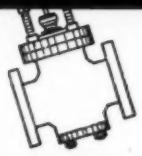
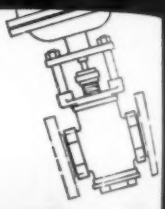
For complete data, capacity charts, prices, selection procedures, etc., send for your copy of the ARMSTRONG STEAM TRAP BOOK.

ARMSTRONG MACHINE WORKS
812 Maple Street • Three Rivers, Michigan

SAVE COAL!
Keep your traps in good repair. Ask for bulletin on trap inspection and repair.

SERVICE	TYPE OF TRAP
1. HIGH PRESSURE or where all steel fittings are desired. (Up to 2400 P.S.I.)	Armstrong Inverted Bucket Steam Trap with FORGED STEEL body and cap. Screwed or flanged connections. 
2. MEDIUM PRESSURE — coils, kettles, headers, etc. (Up to 250 P.S.I.)	Armsrong Inverted Bucket Trap with cast semi-steel body and cap and same stainless steel mechanism used in forged steel traps. Side-inlet side-outlet or bottom-inlet top-outlet connections. 
3. LOW PRESSURE—unit heaters, coils, etc. (From 1 P.S.I. up.)	Identically the same traps, except for part sizes, as No. 2 above!
4. WHERE LARGE AMOUNTS OF AIR MUST BE HANDLED —such as on "up-and-down" process units and low pressure heating systems. (Pressures to 250 lbs.)	Armstrong Inverted Bucket BLAST TRAPS capable of handling 500 to 1500 cu. ft. of free air per hour, depending upon bucket size. 
5. WHERE EXCESSIVE AMOUNTS OF CONDENSATE MUST BE HANDLED—steam separators, purifiers, hot water heaters, etc. (Pressures to 900 P.S.I.)	Armstrong PISTON OPERATED Compound Traps with capacities up to 300,000 lbs. of condensate per hour.
6. WHERE PULSATING PRESSURES ARE ENCOUNTERED such as caused by reciprocating engines and pumps. (Pressures to 600 P.S.I.)	Armstrong Inverted Bucket Traps with special separating chambers. 

STEAM TRAPS for POWER PROCESS HEATING

Controls you

What it means to buy controls from "An Associated Company"

Broad experience and good judgment are the two vital elements which add that extra factor of dependability to a product bearing the "Associated Company" trademark.

Products need more than good design to make them outstanding — they need long years of field observation, — plus the mature judgment of an experienced engineering and production staff.

The pooling of "Associated Company" talent, — the sum total of all the years of member field work, — the combined thinking of member engineering and production staffs,— distinguish the products *AND* the service of "Associated Companies."

This expanding pool of ideas and experience constitutes the basis by reason of which that priceless ingredient — dependability — can be insured to the customer,— dependability in product performance,— dependability of engineering information offered by all "Associated Companies."

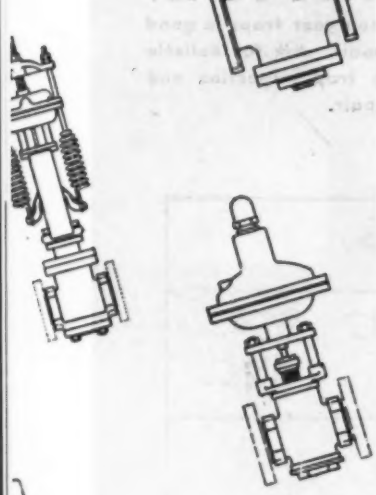
Controls illustrated are manufactured by

SCHADE VALVE MANUFACTURING CO.
2727 No. Bodine Street — Philadelphia 33, Pa.

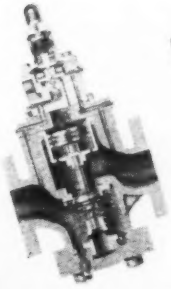
MARINE AND INDUSTRIAL PRODUCTS CO.
1526 Vine Street — Philadelphia 2, Pa.

Associated Companies of

Associated Valve & Engineering Co.
510 N. Dearborn St. — Chicago 10, Ill.

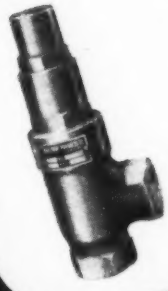


can depend upon!



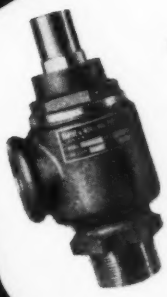
Schade No. 230 Reducing Valve

Self contained internal pilot operated pressure regulating valve is especially designed for severe service. It is suitable for intermittant and dead end service where positive and dependable regulation is required.



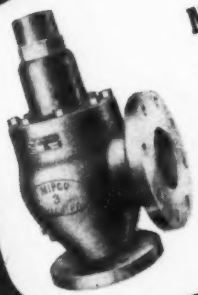
MIPCO Class L Series 50 Relief Valve

Forged steel relief valves designed for high pressure use on liquids and vapors that would be corrosive to bronze. Bodies are forged steel with cast steel bonnet and cap; seat, disc and stem are nickel alloy steel.



MIPCO Class L Series 1 Relief Valve

All Bronze relief valves are designed especially to relieve excessive pressure on pumps, presses, unfired vessels and similar equipment where lines are carrying materials which will not corrode bronze.

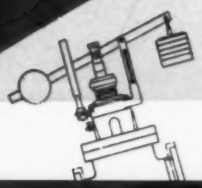


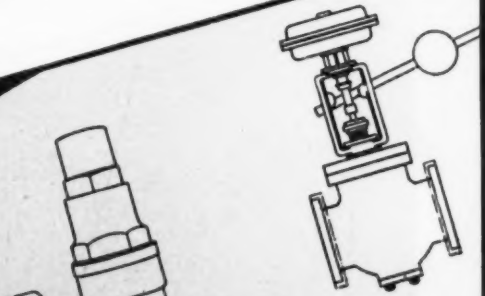
MIPCO Class L Series 100 Relief Valve

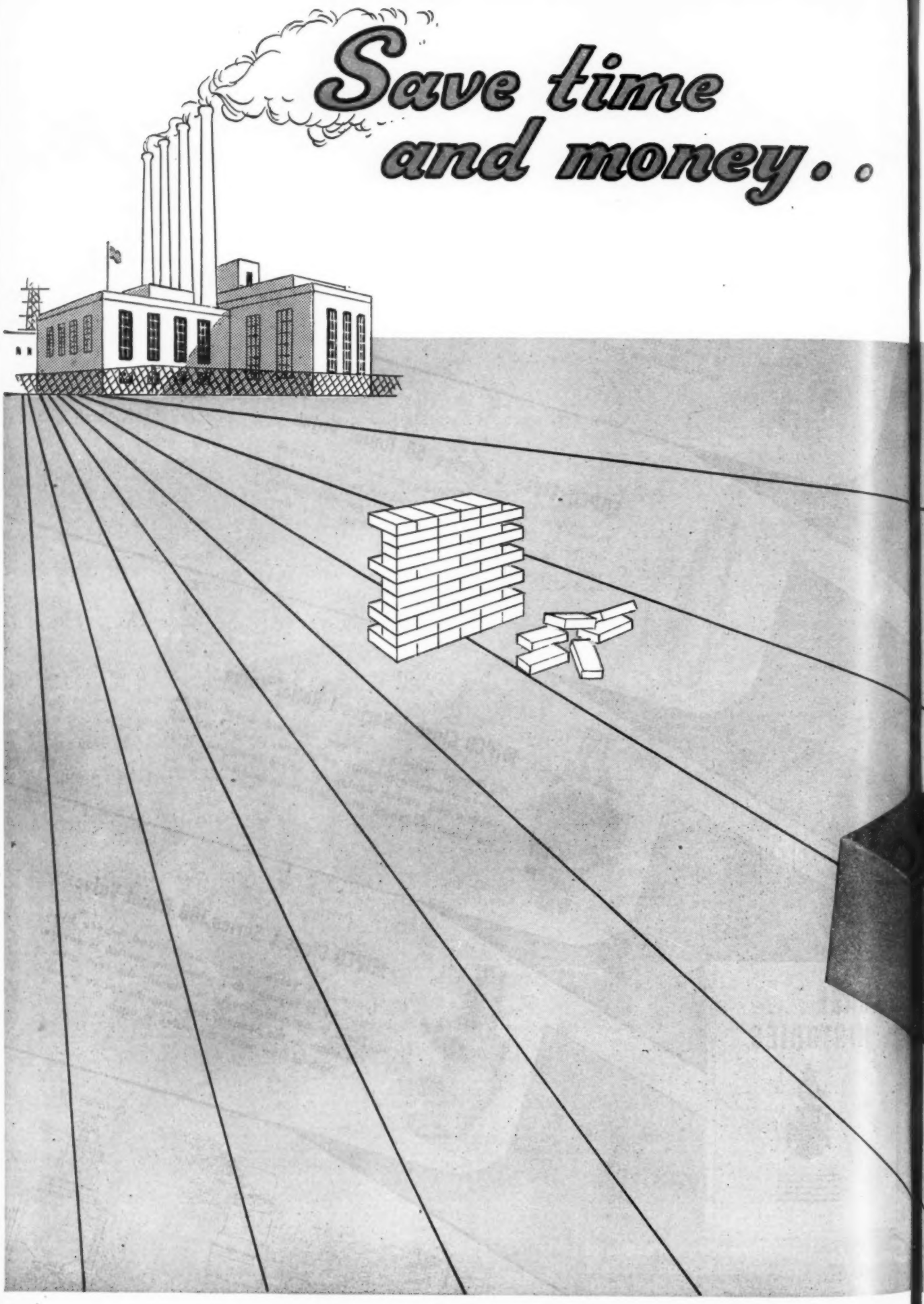
Top guided valves are recommended where high capacity is required and where the service is severe. There is no restriction in the throat; the seat area is the same as the nominal pipe size; the spring is out of the path of flow when the valve is open.

CASE .... HISTORIES

Send for this informative collection of case histories—you will find many examples of special control problems and their solutions. No obligation, of course.






Save time
and money . .

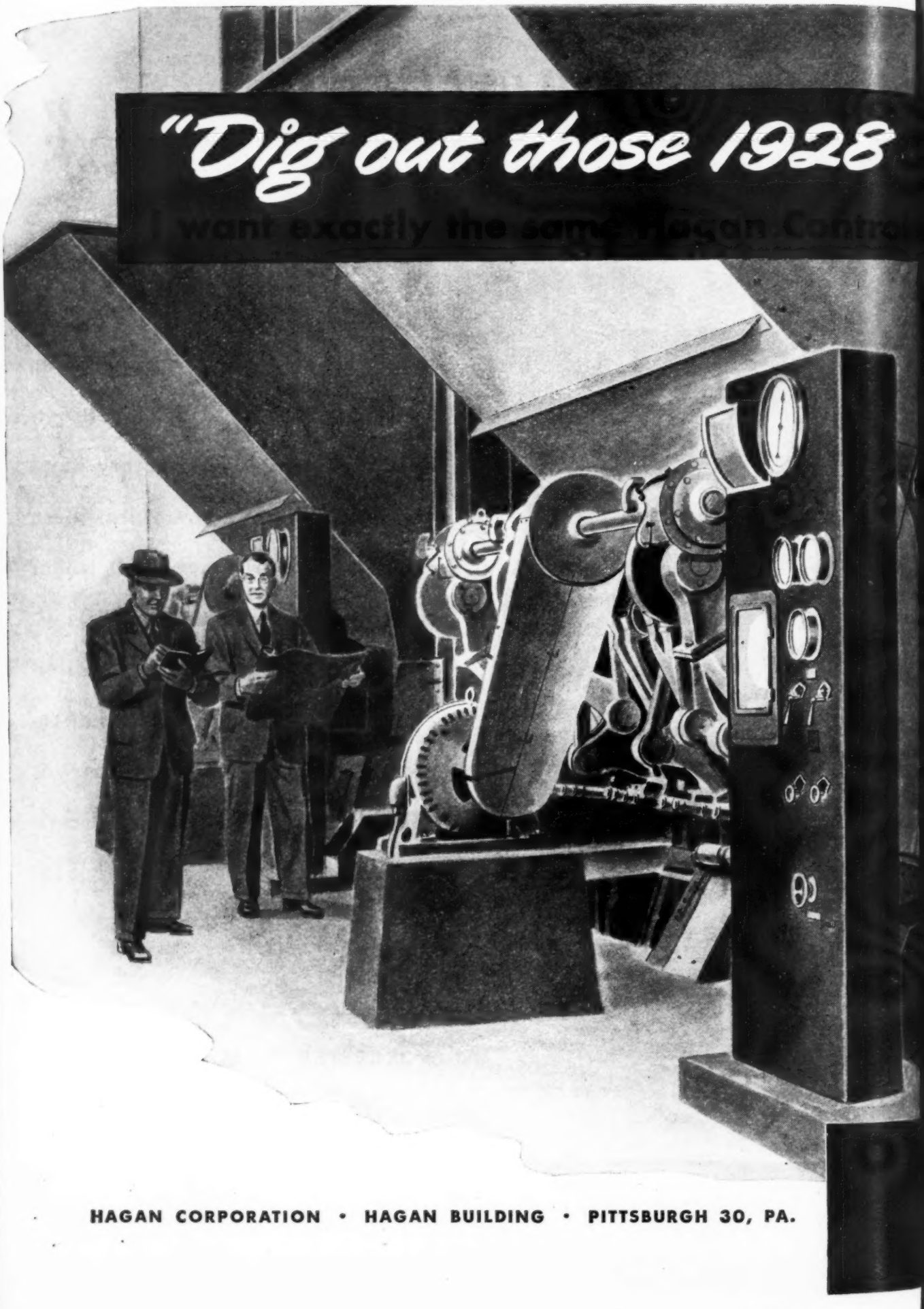
. . . with CRYSTOLON brick

NORTON CRYSTOLON Brick are bringing real savings in time and money to power plant operators. Densely constructed of silicon carbide plus a highly refractory bond and fired at high temperatures these rugged brick will not spall under peak operating conditions. Their dense surface resists slag adhesion and penetration making clinker removal a short, easy operation. CRYSTOLON Brick are unaffected by the corrosive action of coal ash slag.

R-872

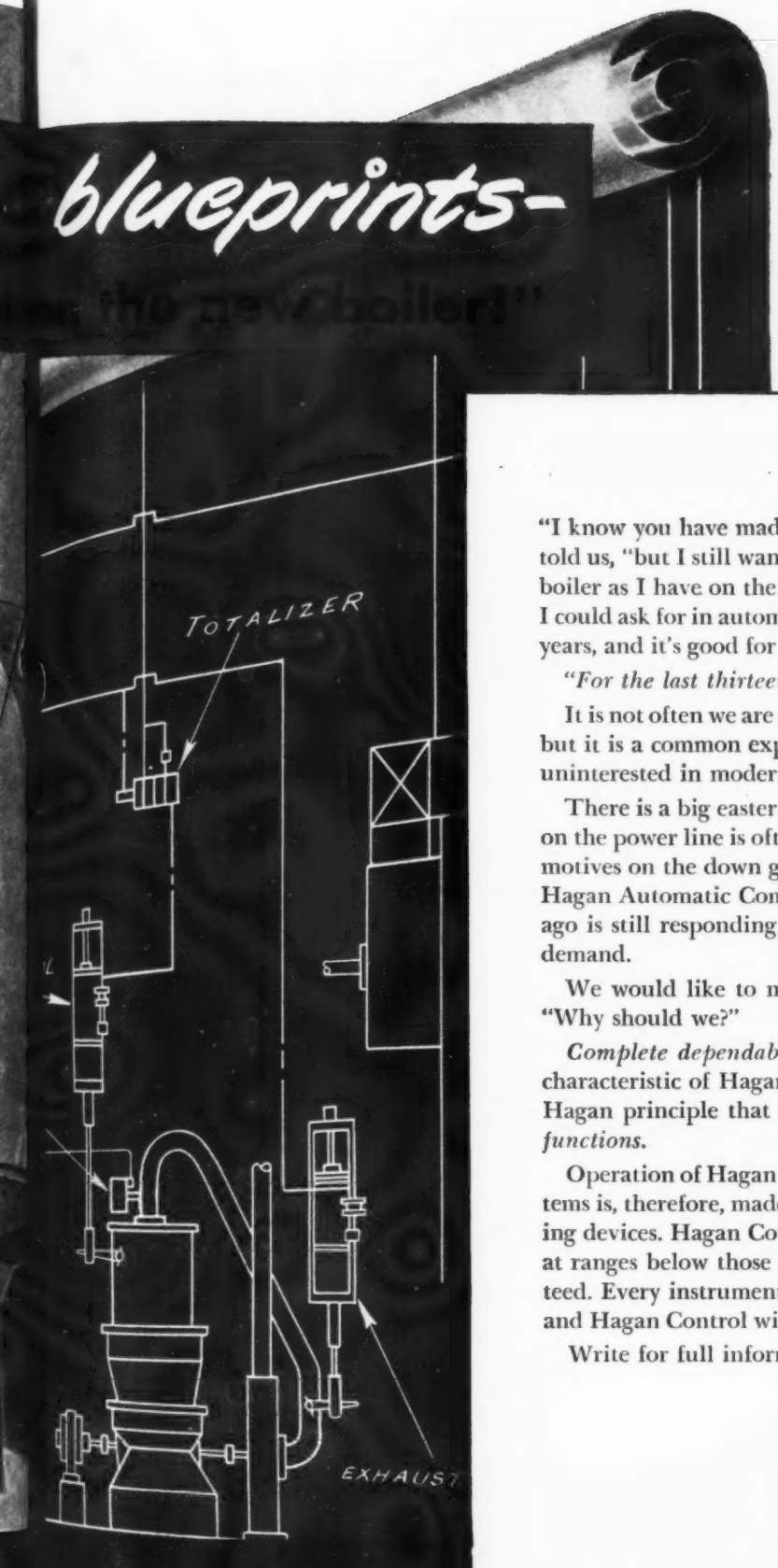
NORTON COMPANY
WORCESTER 6, MASSACHUSETTS

Norton Longer Lasting Refractories



HAGAN CORPORATION • HAGAN BUILDING • PITTSBURGH 30, PA.

blueprints-



"I know you have made improvements in the system," he told us, "but I still want exactly the same thing on the new boiler as I have on the old. That has given me everything I could ask for in automatic combustion control for sixteen years, and it's good for another sixteen."

"For the last thirteen years I haven't even touched it!"

It is not often we are called on to duplicate an old model, but it is a common experience to find users of old models uninterested in modernization.

There is a big eastern railroad, for example, where load on the power line is often less than zero when electric locomotives on the down grade feed power back into the line. Hagan Automatic Combustion Control installed 15 years ago is still responding perfectly to this wide variation in demand.

We would like to modernize that setup, but they say, "Why should we?"

Complete dependability over a long period of years is characteristic of Hagan Control, primarily because of the Hagan principle that *control and recording are separate functions.*

Operation of Hagan Automatic Combustion Control systems is, therefore, made entirely independent of all recording devices. Hagan Control continues to function reliably at ranges below those at which meter accuracy is guaranteed. Every instrument on the panel can be out of service and Hagan Control will still be on the job.

Write for full information.

HAGAN
HALL
BUROMIN
CALGON

HAGAN *Automatic* COMBUSTION CONTROL

1 Pill for 9 Headaches!

PAGES FROM "A GUIDE TO WARTIME CARE OF ELECTRIC MOTORS"

ALL NINE electric motor enemies are present and accounted for in Allis-Chalmers' new "Guide to Wartime Care of Electric Motors." Streamlined instructions and story-telling pictures describe what they are, where they're found, how to fight them.

Designed for wartime U. S. industry, "Guide to Wartime Care of Electric Motors" has aroused such world-wide demand that Spanish and Portuguese editions are now printing!

You'll find this valuable new handbook ideal both for training new men and "brushing up" old hands. It contains no advertising. Write today for *your* free copy of this tremendously successful handbook to ALLIS-CHALMERS MFG. CO., MILWAUKEE, WISCONSIN. A 1625

ALLIS-CHALMERS MOTORS

When you do need new motors, look into the strength, solidity and all-around protection of the new "Safety Circle"—protected top, sides, ends and bottom.

SUN GLASSES

SKIING GLASSES

SWIMMING GOGGLES

WELDING GOGGLES

IN METALS TOO
It all depends on what you want to do

SELECTION GUIDE TO INCO NICKEL ALLOYS

PROPERTY:	MONEL	"R" MONEL	"K" MONEL	"KR" MONEL	"S" MONEL	NICKEL	"Z" NICKEL	INCONEL
CORROSION RESISTANCE	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH
STRENGTH	GOOD	GOOD	HIGH	HIGH	GOOD	GOOD	HIGH	GOOD
TOUGHNESS	GOOD	GOOD	HIGH	GOOD	GOOD	HIGH	HIGH	HIGH
HARDNESS	GOOD	GOOD	GOOD	GOOD	HIGH	FAIR	HIGH	GOOD
MACHINABILITY	GOOD	HIGH	GOOD	HIGH	GOOD	GOOD	GOOD	GOOD
NON-GALLING	NO	NO	NO	NO	HIGH	NO	NO	NO
SPRING PROPERTIES	GOOD	NO	HIGH	NO	NO	GOOD	HIGH	HIGH
ELEC. CONDUCTIVITY	POOR	POOR	POOR	POOR	POOR	GOOD	GOOD	POOR
HEAT RESISTANCE	GOOD	GOOD	GOOD	GOOD	HIGH	GOOD	GOOD	HIGH
HEAT TREATABLE	NO	NO	YES	YES	YES	NO	YES	NO
NON MAGNETIC	NO	NO	YES	YES	YES	NO	NO	YES

When it's a question of finding a metal for some tough job you have in mind there is a quick way to look for a ready answer...

Take a look at the family of Inco Nickel Alloys—strong, hard, corrosion-resisting and absolutely free from rusting, every one of them. Those are the family characteristics of the eight Inco Nickel Alloys.

Which one should you choose for your particular job?

It all depends on what you want to do.

From this "Selection Guide" you can see how each one provides a different combination of advantages for different types of work.

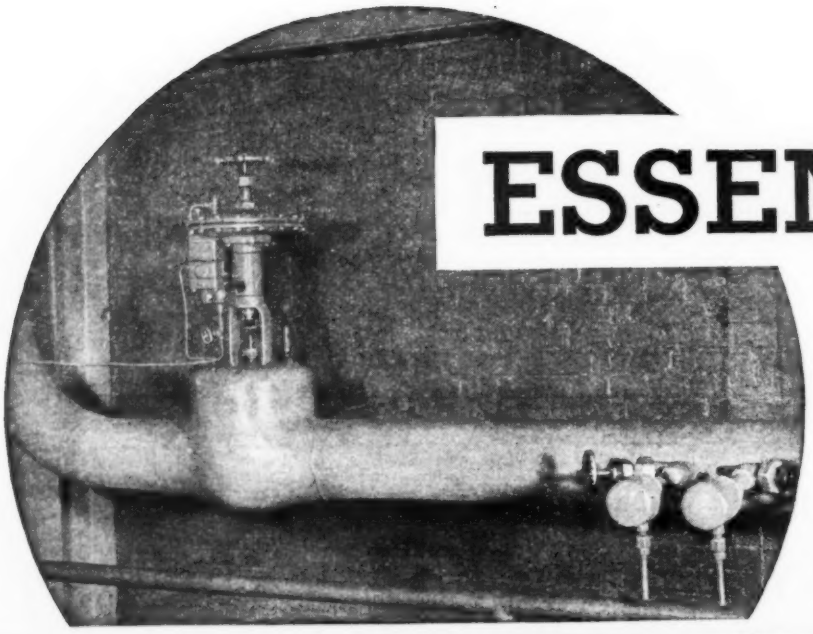
Then write for a copy of our List "B-100" which lists more than 100 technical bulletins and publications that explain the properties, corrosion-resisting characteristics and practical applications of these INCO Nickel Alloys. It is yours for the asking.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

Photo credits (left to right): Ewing Galloway, N. Y.—American Spectacle Co., N. Y.
American Spectacle Co., N. Y.—Black Star, N. Y.

NICKEL (INCO) ALLOYS

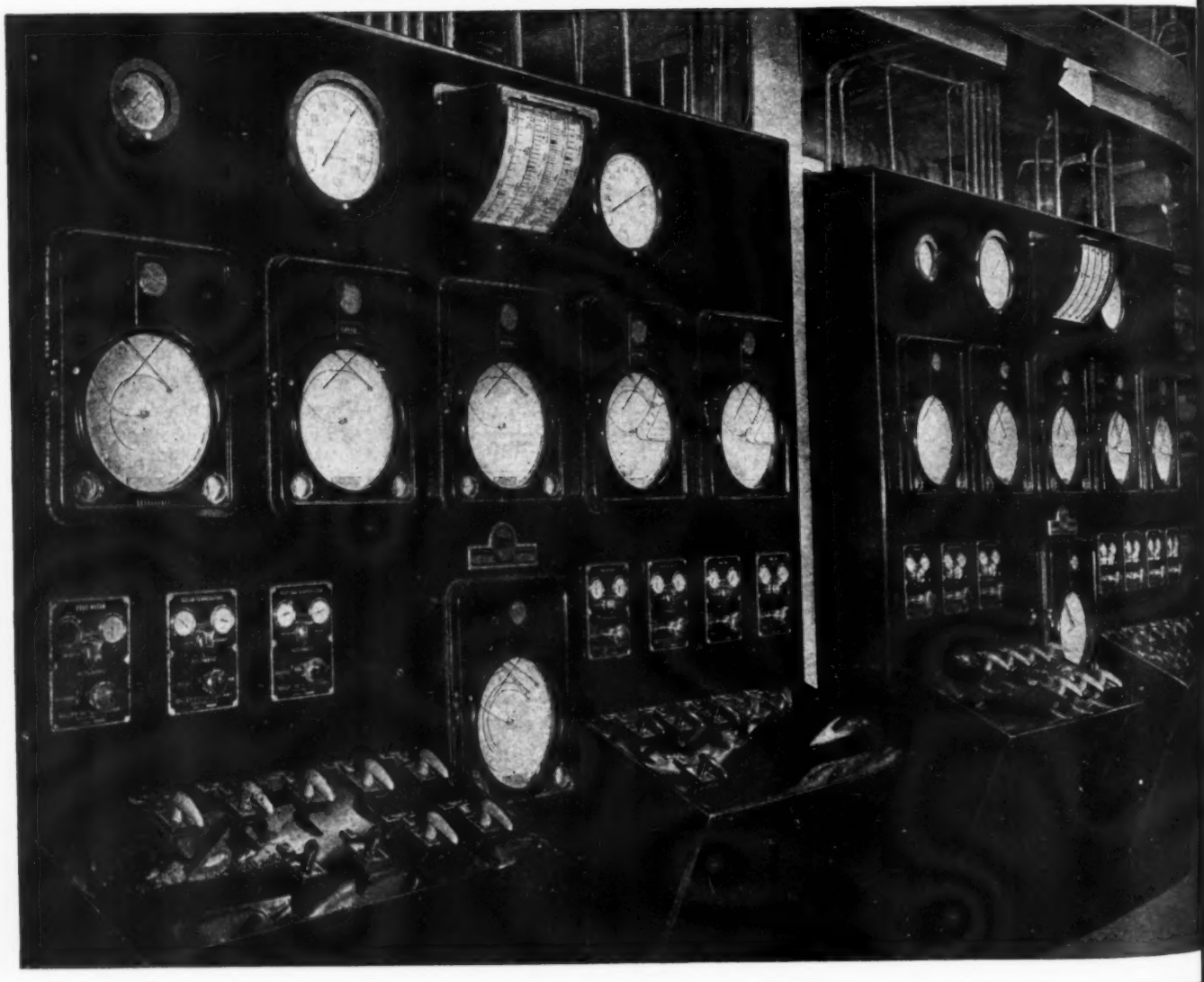
MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL • Sheet . . . Strip . . . Rod . . . Tubing . . . Wire . . . Castings . . . Welding Rods (Gas & Electric)



ESSENTIAL

Bailey Feed Water Control Valve

Bailey Boiler Control Panels for two 135,000 lb. per hour capacity, oil and gas-fired boilers in a Western Power Station.



BAILEY METER CONTROL

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHE

IN *WAR,* PROFITABLE IN *Peace*

Bailey Boiler Control Conserves Fuel, Insures Safety, Increases Turbine Efficiency, Improves Continuity of Service and Simplifies Training of Operators . . . . .

★ The same qualities of Bailey Boiler Control which make it essential in wartime power plant operation, make it profitable to use in peacetime operation.

It conserves fuel and fuel transportation facilities by automatically maintaining the correct fuel—air ratio for efficient combustion at all times.

It insures against accidents to operators and equipment by:

Accurate control of boiler water level, steam temperature and fuel—air ratio.

Interlocks to insure the proper sequence of operation.

Limiting devices to prevent operation under unstable conditions.

Alarms to warn operators of dangerous conditions such as high or low water level, flame failure, loss of air pressure, etc.

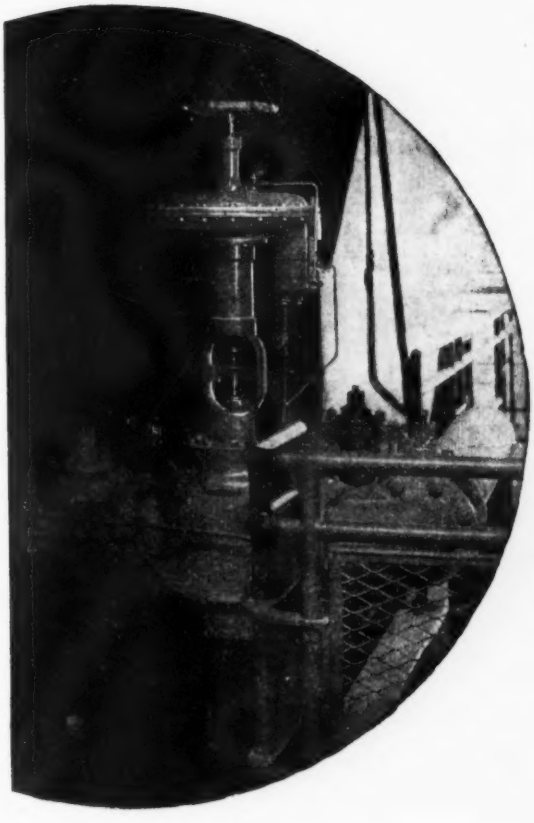
It increases turbine efficiency by supplying steam at design pressure and temperature at all times.

It improves the continuity of service by reducing furnace and boiler repairs.

It simplifies training of new operators and insures continuous economy during the training period.

These same qualities of Bailey Boiler Control which are now helping to win the war will help American industry to win the peace.

Suggestions for wartime boiler plant operation are given in our Bulletin No. 16 "How to Safely Stretch Steaming Capacity." Ask for your copy now. A-90



Bailey Gas Flow Control Valve.

BAILEY METER COMPANY

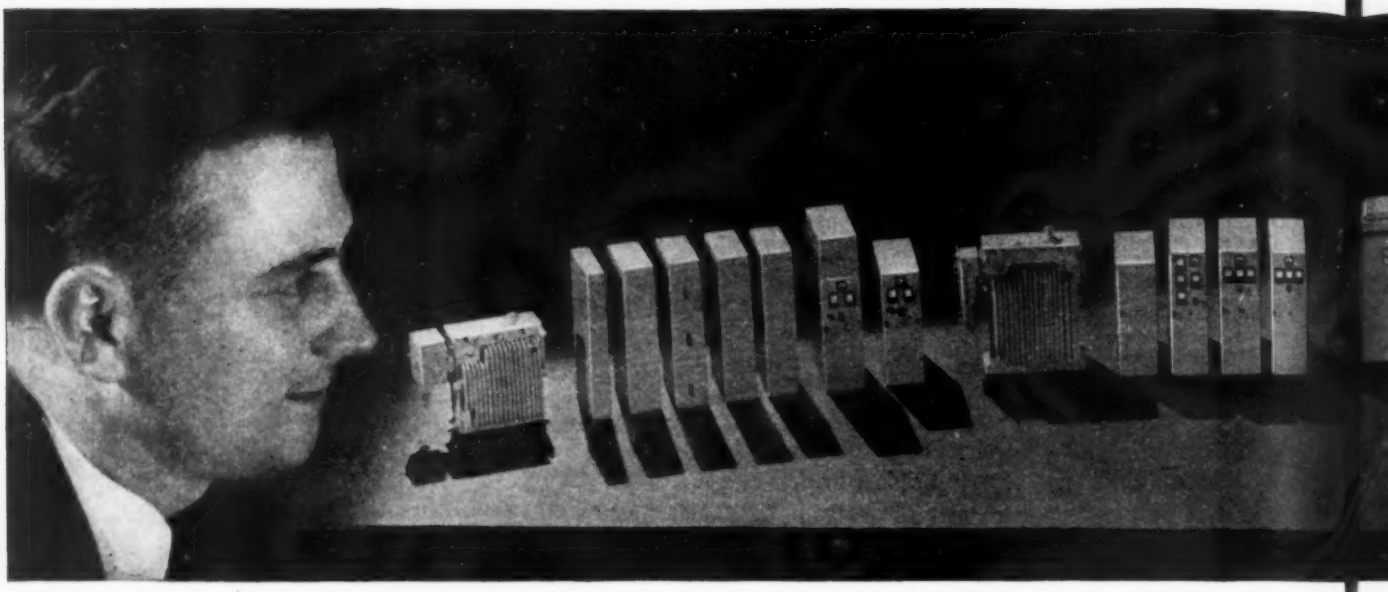
1036 IVANHOE ROAD • CLEVELAND, OHIO

Bailey Meter Company Limited, Montreal, Canada

he Complete Combustion Control System

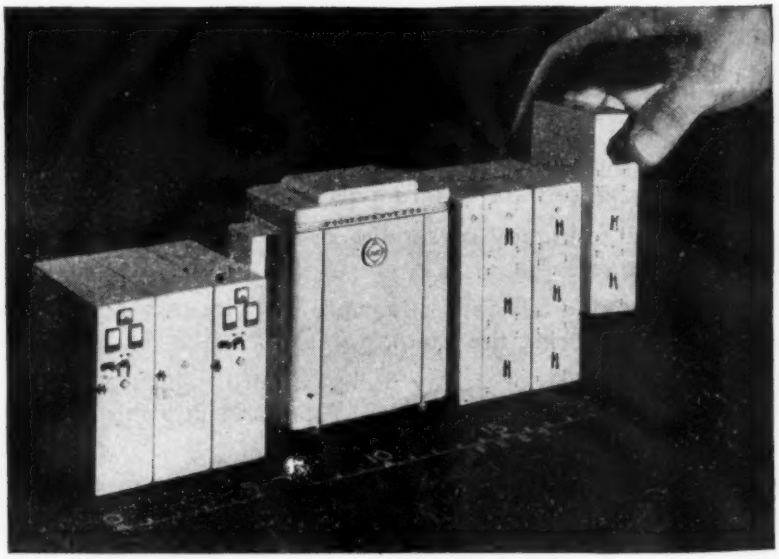
NTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

Here's what you



Here's how you

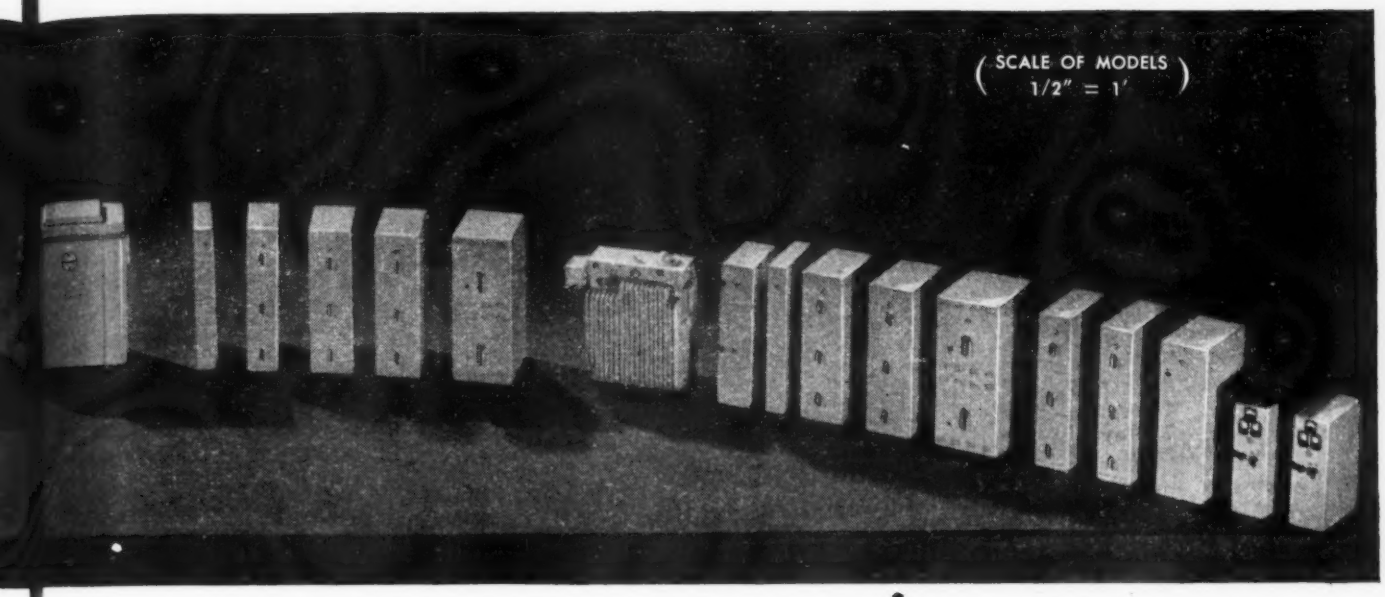
1 YOU SEE WHAT'S AVAILABLE — without bogging down in tables, charts, diagrams. Accurately constructed—½ in. to 1 ft — models eliminate all guesswork in unit substation planning. And they're idea-stimulating . . . hard to keep your hands off.



2 YOU EXPERIMENT. Unit substation arrangements are assembled quickly . . . allowing easy comparison of alternate plans. Thirty-eight models permit you to see for yourself the great flexibility of Allis-Chalmers unit sub equipment . . . determine the *right* substation for your plant. A field engineer from your nearby A-C district office will be glad to show the models. There's no obligation.

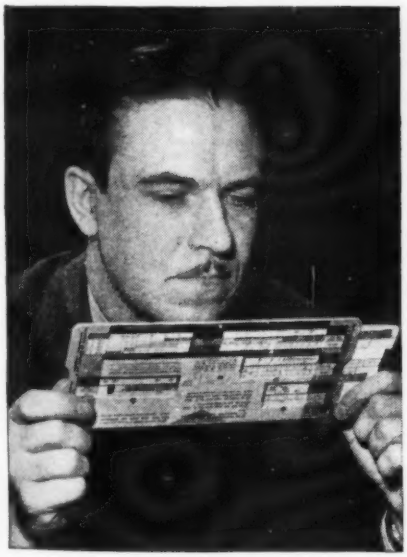
SEE YOUR UNIT SUB IDEAS WORKED OUT WITH ALLIS-

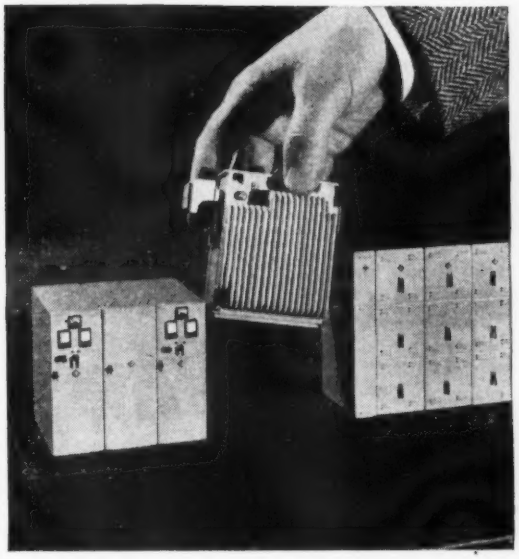
have to work with



work:

When you use Allis-Chalmers scale models to help solve Unit Sub problems!





3 YOU DETERMINE what size circuit breakers will be needed when you use Allis-Chalmers' handy Unit Sub Slide Rule to calculate secondary short circuit current quickly, easily, accurately.

4 YOU VISUALIZE SOLUTIONS to your power distribution problems right on the top of your desk. At a glance, you see what space your proposed unit substation will occupy. You also see how it will look when actually installed in your plant.

5 YOU DOUBLE CHECK with A-C's Check List book which reduces every basic consideration in unit sub planning to its simplest possible form.

♪ *Tune in the Boston Symphony, Blue Network, every Saturday at 8:30 pm, EWT.* A 1828

CHALMERS "UNIT SUB BUILDER" SET

B. t. u. Savers

CO_2 METERS

An Automatic Orsat—For Checking Combustion Efficiency

For every fuel and boiler, there is a definite percentage of CO_2 in the flue gas that will assure highest combustion efficiency. Less than this amount indicates an excess of combustion air, causing high stack loss. The CO_2 meter is the only method of accurately determining combustion efficiency.

WRITE FOR DATA BOOK No. 403

RECORDING THERMOMETERS

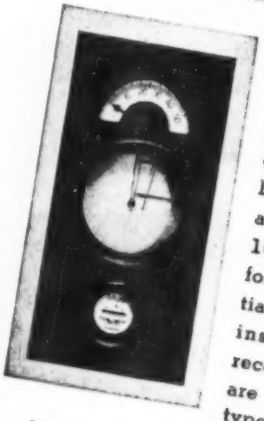
Remote Reading—Single and Multiple Pen

Republic thermometers are available for recording temperature of flue gas, temperatures in vats or tanks either open or closed and under pressure, temperatures in pipe lines, refrigeration systems, ovens, kilns or ducts. For unusual conditions, special bulbs are furnished of corrosion resisting metal or with a protective coating.

WRITE FOR DATA BOOK No. 210

FLOW METERS

Electrical Remote Reading Type



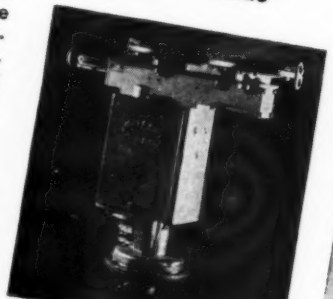
Republic electrical type flow meters are available for measuring the flow of all types of liquids and gases. Meter bodies are built for metering fluids at line pressures up to 10,000 lb. per sq. in. and for all ranges of differential pressure. The reading instruments — indicator, recorder and integrator — are of the remote reading type.

WRITE FOR DATA BOOK No. 701

REGULATORS

Pressure—Flow—Speed—Level—Ratio

Republic hydraulic or pneumatic type regulators are supplied for the automatic control of pressure, rate of flow, speed of rotation, level of a liquid or the proportioning of two pressures, flows, etc., in a fixed ratio by mechanically operating a valve, damper, rheostat or various types of variable speed transmissions.



WRITE FOR DATA BOOK No. S-13

FLOW METERS

Mechanical Float Type

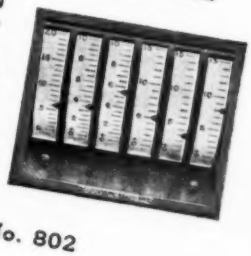
The Republic mechanical float type meter is a simple, accurate metering device for measuring the flow of steam, water, gas, compressed air, oil, brine and other fluids. It has been designed primarily for installations where remote registration is not required.

WRITE FOR BULLETIN No. 312

DRAFT AND PRESSURE INSTRUMENTS

Diaphragm Actuated Any Number and Combination

Proper regulation of draft is one of the most important requirements in obtaining highest combustion efficiency. For indicating and recording drafts, pressures and differentials, Republic dry-bellows type indicators and recorders are supplied for all ranges encountered in furnace operation in any desired combination.



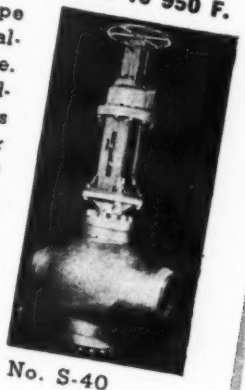
WRITE FOR BULLETIN No. 802

...that will help you stretch your fuel supply

PRESSURE REDUCING AND REGULATING VALVES

Pressure To 2500 lb.—Temperatures To 950 F.

Republic turbine type valves are of the gradual-opening, high-lift type. They are built in accordance with A.S.A. standards and can be supplied for all pressures up to 2500 lb. per sq. in. and for temperatures up to 950 F and for any specified capacity. Republic valves will regulate down to 2% of maximum flow.

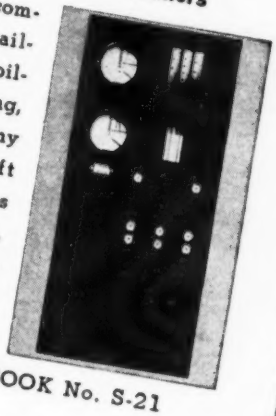


WRITE FOR BULLETIN No. S-40

COMBUSTION CONTROL

For All Sizes and Types of Boilers

Republic automatic combustion control is available for all sizes of boilers, all types of fuel firing, all load conditions and any arrangement of draft equipment. It maintains constant steam pressure, highest combustion efficiency, desired load division, constant furnace draft.



WRITE FOR DATA BOOK No. S-21

DESUPERHEATERS

Built To Meet Your Specific Requirements

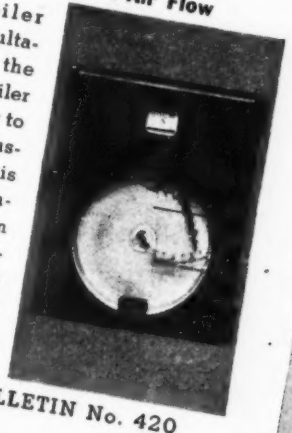
Whatever your plant conditions, you can obtain the necessary operating flexibility and accurate regulation of steam temperature with rugged, simply-controlled Republic desuperheaters. These are of the venturi type, with ratio or ratio-tank control, the steam atomizing type and the mechanical atomizing type.

WRITE FOR DATA BOOK No. S-35

BOILER METERS

Record Steam Flow-Air Flow

The Republic Boiler Meter records simultaneously on one chart the steam flow from the boiler and the rate of air flow to the furnace for combustion. The air flow pen is adjusted to record coincident with the steam flow pen when the furnace is receiving the proper amount of air for maximum combustion efficiency.



WRITE FOR BULLETIN No. 420

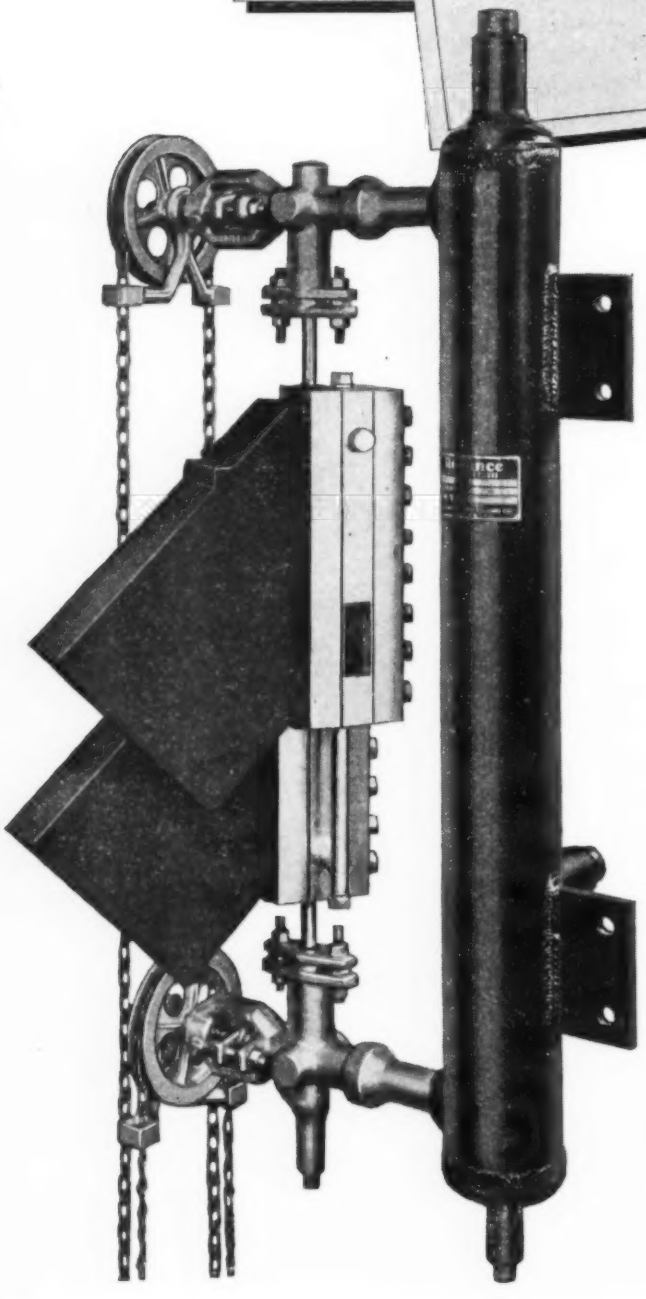
REPUBLIC
INSTRUMENTS
AND CONTROLS

Republic Flow Meters Co.

2222 Diversey Parkway • Chicago 47, Illinois

It will pay you to specify Reliance

Custom Built

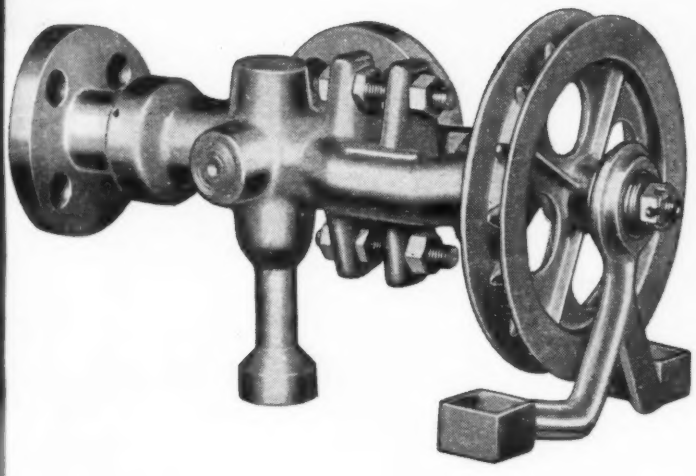


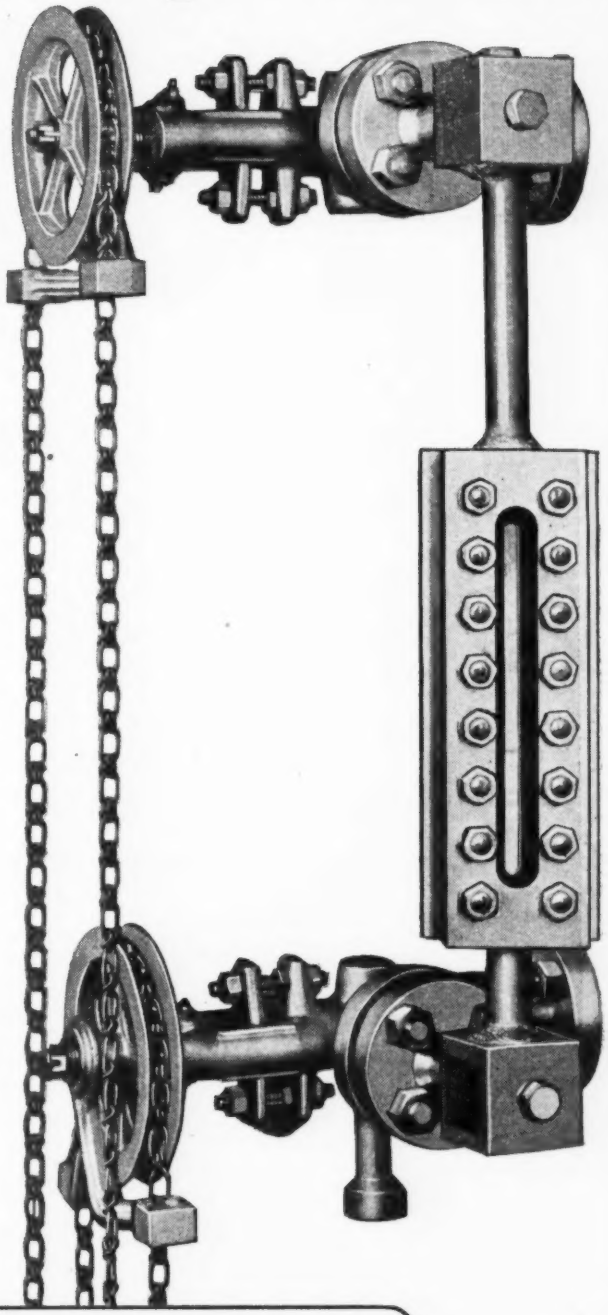
WHEN you plan or design new or modernized high pressure power plants, the specially built equipment you'll specify may well include Reliance Water Columns, Gages and Gage Illumination. Your requirements may call for adaptations skillfully engineered to gain desired results not obtainable through standard equipment.

Standardization contributes important savings in average installations and in many special plants. Reliance builds boiler safety devices in a wide range of styles and capacities, supplying appropriate equipment for thousands of boilers. But when unusual requirements occur, Reliance has the background of experience—a pioneer in this field since 1884—

Catalog 415 describes Reliance Water Columns and Gage Equipment for pressures above 250 pounds.

water level indication for your "super-duty" boilers





to guide special designing, and craftsmen who can undertake out-of-the-ordinary workmanship with a sure hand.

New power techniques, higher working steam pressures, find Reliance ready to supply water level indication equipment having the necessary ruggedness, safety features and whatever special engineering is needed for the individual installation.

•Left hand page: Forged steel water column for 2000 p.s.i. service — all-welded construction, with mica-protected flat glass insert, heavy-duty gage valves, direct vision hoods •Above: Newest type forged steel gage valve with welding neck blow-down, chain-wheel oper'n •Right: Special gage assembly for direct-to-drum connection.

BOILER SAFETY DEVICES since 1884

Reliance

THE RELIANCE GAUGE COLUMN CO. · 5902 CARNEGIE AVENUE · CLEVELAND 3, OHIO

● Fig. 2125—125-lb. S. P. Bronze Gate, Double Disc, Rising Stem

● Fig. 16—Bronze "RENEWO" GLOBE

ULES SUPREME IN PRODUCTION OF...

LUNKENHEIMER VALVES

● At every step in manufacture, *Quality is the watchword at Lunkenheimer . . .*

Quality you can see in every line of a Lunkenheimer valve . . . plus *built-in* quality that reveals itself in top performance and longer service life when these finer-made valves are put to work.

Simplicity of design, correct proportions and perfect balance of all parts, reduce maintenance costs to a very minimum.

On every industrial front, Lunkenheimer Valves are proving their exceptional staying qualities.

A Lunkenheimer Distributor is located near you, ready at all times to assist with your maintenance and operating problems.

ESTABLISHED 1862
THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI 14, OHIO, U. S. A.
NEW YORK 13 CHICAGO 6
BOSTON 10 PHILADELPHIA 7
EXPORT DEPT. 318-322 HUDSON ST., NEW YORK 13, N. Y.

BRONZE, IRON, STEEL AND CORROSION RESISTANT ALLOY VALVES, 125 TO 2500 LB. S. P.; BOILER MOUNTINGS, LUBRICATING DEVICES, AIRCRAFT FITTINGS

WATER CONDITIONING CONTROL with BETZ SERVICE

W. H. & L. D. BETZ — **PHILADELPHIA 24, PA.**

Date: January 10, 1945

For: [redacted] Paper Company
Plant No. 2
Syracuse, New York

BOILER WATER

Test Limits

Phosphate (PO_4)	-	30 - 60	ppm
Alkalinity (P)	-	200 - 400	ppm
Sulfite (SO_3)	-	20 - 40	ppm
Specific Conductance	-	2500 - 3500	micromhos

Control

1. Always feed organic colloid and anhydrous disodium phosphate in the ratio of 1 pound colloid to 2 pounds disodium phosphate.
2. If soluble phosphate content of boiler water is less than 30 ppm increase colloid and disodium phosphate. If soluble phosphate exceeds 60 ppm decrease colloid and disodium phosphate.
3. If P alkalinity of boiler water is less than 220 ppm increase caustic soda. If P alkalinity exceeds 400 ppm decrease caustic soda.
4. If sulfite content of boiler water is less than 20 ppm increase sodium sulfite. If sulfite content exceeds 40 ppm decrease sodium sulfite.
5. If specific conductance of boiler water exceeds 3500 micromhos increase blowdown. If specific conductance is less than 2500 micromhos blowdown may be decreased.

   NOTE: Blowdown should never be reduced below a minimum of 1 sludge blow per boiler per day

6. Record results of daily plant tests on forms provided and mail eve to our Philadelphia Laboratories.
7. Limits and control are subject to revision at any time dependen operating conditions or changed feedwater characteristics.

JDB AD

No. 2 in a series of advertisements outlining the fundamentals of Betz service.

HOW BETZ ESTABLISHES *Individual* BOILER WATER CONTROL

• Proper boiler water conditioning requires far more than the mere addition of a fixed amount of chemicals to the boiler water. It has been repeatedly proved that a system of control must be established to compensate for daily variations in operating conditions and feedwater characteristics; otherwise, costly over-treatment or dangerous under-treatment will inevitably result.

An essential part of the complete supervisory service extended by W. H. & L. D. BETZ is the establishment of this vitally-important plant control. An individually designed control chart (shown in typical form on the facing page) is prepared from our study of plant operating data and water characteristics. Upon delivery to the plant by a Betz engineer its application is thoroughly explained to the plant personnel. This chart outlines the steps to be taken in maintaining proper boiler water balances at all times with respect to both chemical treatment and blowdown. A similar chart is prepared for the control of external treatment. Our engineer then aids in the initial establishment of proper chemical balances as recommended by these control charts. A few simple, daily chemical tests recommended to maintain the proper balances are also explained. In this manner, a complete understanding of the desired feedwater correction and control is assured from the outset.

Unscheduled boiler outages can be prevented through the supervisory services and control of W. H. & L. D. BETZ. Our engineers and chemists know how to keep boilers operating 'round the clock. Years of experience with all types and sizes of installations and with widely varying feedwaters enables Betz to render a boiler water service that is complete for all industries, with individual recommendations and control for each plant.

W. H. & L. D. BETZ

Gillingham & Worth Sts., Philadelphia 24, Pennsylvania

THE 6 FUNDAMENTALS OF BETZ BOILER WATER CONDITIONING SERVICE

1. Complete plant investigation and report.
2. **Establishment of plant control.**
3. Daily plant control tests.
4. Detailed review of plant tests and report.
5. Supplementary complete laboratory analyses.
6. Periodic "check-up" visits.

CHEMICAL ENGINEERS AND CONSULTANTS ON ALL WATER PROBLEMS

BETZ

"Material Spoilage Was Greatly Reduced When We Installed BUSS FUSES In Our Heat Treating Furnace Circuits"

—Mr. John Burchfield,
General Maintenance Supt.,
Iron Fireman Manufacturing Corp.

This is What Happened.. "In 1942 we bought a new furnace controlled by a 400 ampere 220 volt, 3 phase circuit. This furnace pulls right up to the 400 ampere capacity and starting surge is very high, and being fully automatic starts and stops are very frequent, approximately 10 or 12 times in one hour. Ordinary renewable fuses just couldn't take this kind of punishment and blew frequently."

"Each shutdown meant a considerable delay, which often caused spoilage of material. However, we don't worry about this any more for since installing BUSS Super-Lag fuses we eliminated these needless shutdowns."

BUSS

Why BUSS Fuses greatly reduce or entirely prevent needless blows

The fuse case is designed to insure good contact on the link, even when the fuse is renewed by an inexperienced person—and it is so designed that vibration or heavy overloads or the constant heating and cooling of the fuse will not permit poor contact to develop. Thus excessive heating, which causes fuses to blow needlessly, is prevented.

The fuse link used is the famous "BUSS Super-Lag." It has lag-plates attached to it. These give it a time-lag so long that it will reduce to an extent not possible with any other renewable fuse, the number of shutdowns caused by needless fuse blows.

Prevent future trouble in your plant —by doing this today

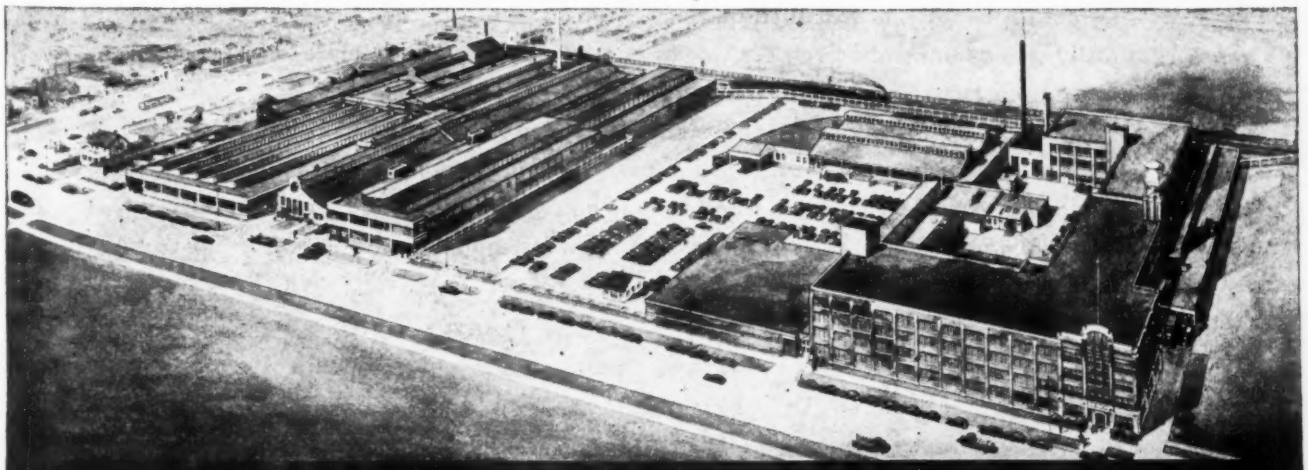
Pass the word along that all purchase records dealing with circuit protective devices should be immediately changed to call for BUSS Super-Lag Renewable fuses. Then, as fuses are replaced or new installations made, your plant will automatically get the benefit of the carefree, trouble-proof protection that BUSS Super-Lag fuses afford.

BUSSMANN MFG. CO., ST. LOUIS 7, MO.
Division McGraw Electric Company

Why BUSS Fuses Don't Blow Needlessly

10 FEATURES
in the design of the FUSE-CASE help make it possible
and

***The* SUPER-LAG**
development in the FUSE-LINK completes the job.



Super Lag FUSES

SOLD THROUGH WHOLESALERS

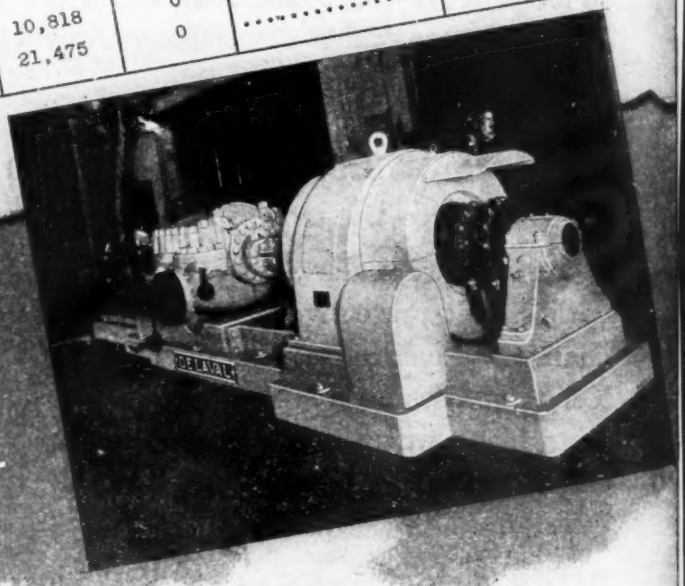
Look at the Record!

SERVICE RECORD—As of September 1, 1944

DE LAVAL FUMPS at ————

No.	Discharge Pressure psig	Suction Temp. °F.	Placed in Service	Total Service Hours	Outages Due to Pump	Cause of Outages	Approx. % Increase in Pump Power
14	1186	260°	12- 2-38	40,383	2	Replace ball locating bearing and shaft sleeves	Negligible
					1	Replace shaft sleeves	Negligible
15	1186	260°	10-11-40	28,839	0	.....	5%
21	1186	350°	8- 4-39	10,818	0	.....	
16	1186	260°	1- 2-42	21,475			

Capacity (all units).....1455 g.p.m.



of DE LAVAL HIGH-PRESSURE BOILER-FEED PUMP PERFORMANCE

Not one major trouble after as much as 40,000 hours of service!

The first of these units was installed in February, 1938; the most recent in February, 1942. All have demonstrated the satisfactory performance of De Laval boiler-feed pumps for high-pressure central station service.

Other important installations, operating at pressures up to 1600 psi and handling high temperature feed water, are operating with equal freedom from trouble, due in no small measure to the excellent performance of the De Laval automatic balancing device, the De Laval large clearance labyrinth wearing rings, and the sturdiness of De Laval solid end head construction.

3629

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DE LAVAL

STEAM TURBINE COMPANY · TRENTON 2, NEW JERSEY

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POWER

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A CROSS-INDEX OF SUBJECTS FOR THE MONTH

PLANT OPERATING METHODS, MAINTENANCE AND SAFETY
STEAM GENERATION, FUELS, FIRING AND COMBUSTION
TURBINES, ENGINES, AUXILIARIES; HYDRO POWER
DIESELS, GAS ENGINES AND ACCESSORIES
AIR CONDITIONING AND REFRIGERATION
ELECTRICAL EQUIPMENT, ELEVATORS
PIPING, VALVES AND SPECIALTIES
TRANSMISSION, LUBRICATION
STEAM SERVICES, HEATING
INSTRUMENTS, CONTROLS
PUMPS, COMPRESSORS

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VOLUME 89, NUMBER 3 • ABC • A McGRAW-HILL PUBLICATION • ABP •

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BALANCED POWER WITH

It takes a balanced rotor to insure smooth operation throughout the full range of turbine speeds. And that's the kind you get in Westinghouse Type C Turbines. Each rotor is *dynamically* balanced by an *exclusive* Westinghouse process that minimizes vibration and bearing wear.

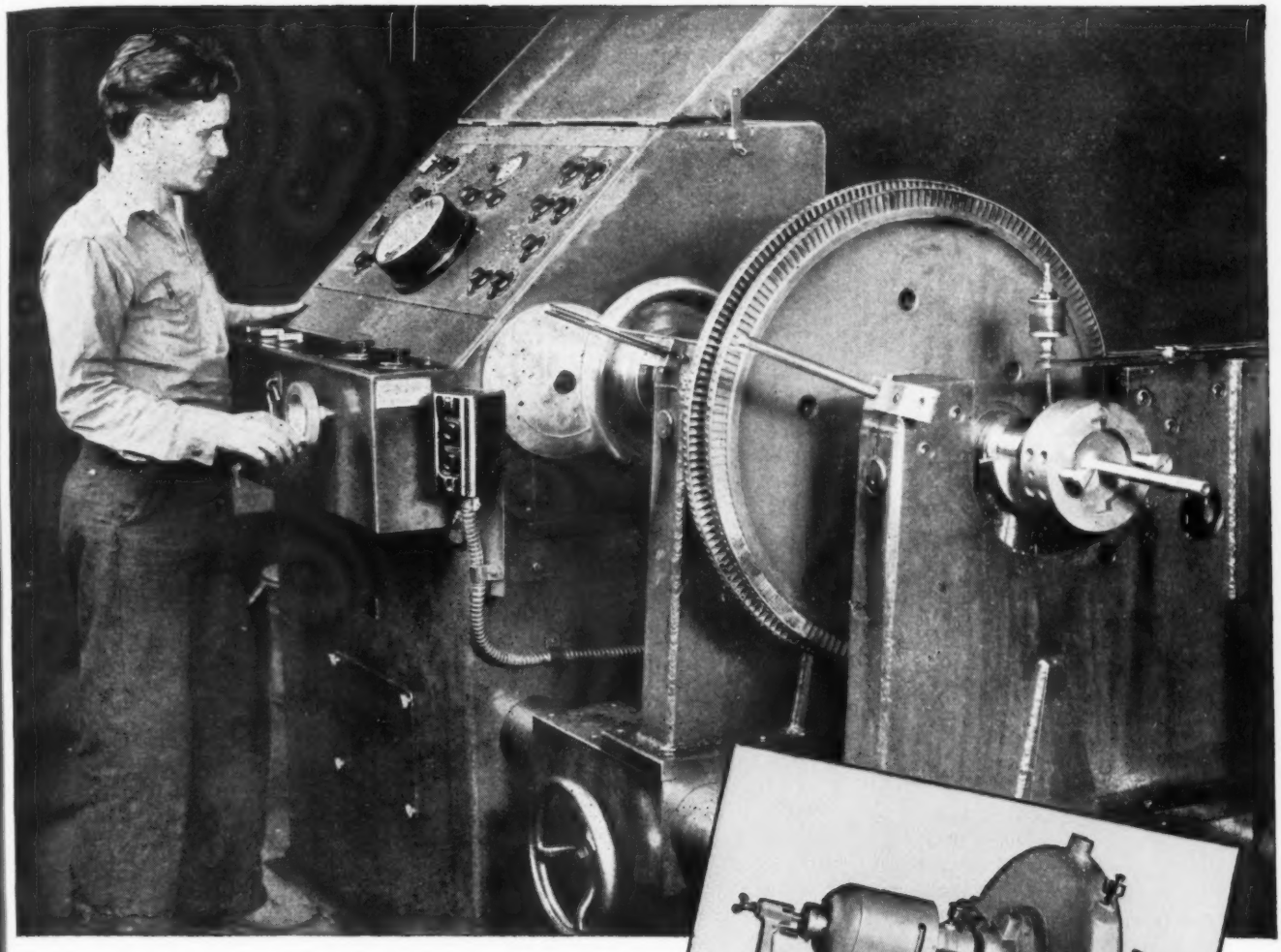
When you buy these general-purpose mechanical drive turbines, you get this added smoothness, added reliability, added economy in operation. Balanced rotors are only one of many plus values that give you extra safety . . . and more dependable operation.

Westinghouse Type C Turbines are built in five different sizes, covering a range of 5 to 1500 hp. The long list of proved-in-service installations includes pumps, forced and induced draft fans, pulverizers, compressors, Jordans, pulp beaters, line shafts, generators—and many other applications where steam drives are used to improve over-all heat balance.

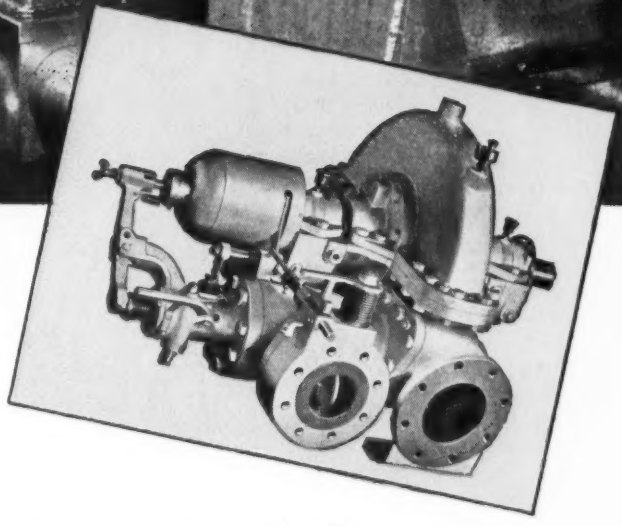
For complete information call your nearest Westinghouse representative. Westinghouse Electric & Mfg. Co., Box 868, Pittsburgh 30, Pa. J-50458

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE



The Dynetric balancing machine on which these turbine rotors are balanced is an exclusive Westinghouse development. It operates electronically to give positive indications of unbalance vibrations.



BALANCED ROTORS

Every Westinghouse Type C Turbine Rotor is statically and dynamically balanced before assembly. Then, to insure preservation of the original perfect balance, a heavy coating of corrosion-resistant paint is applied to the rotor disc.

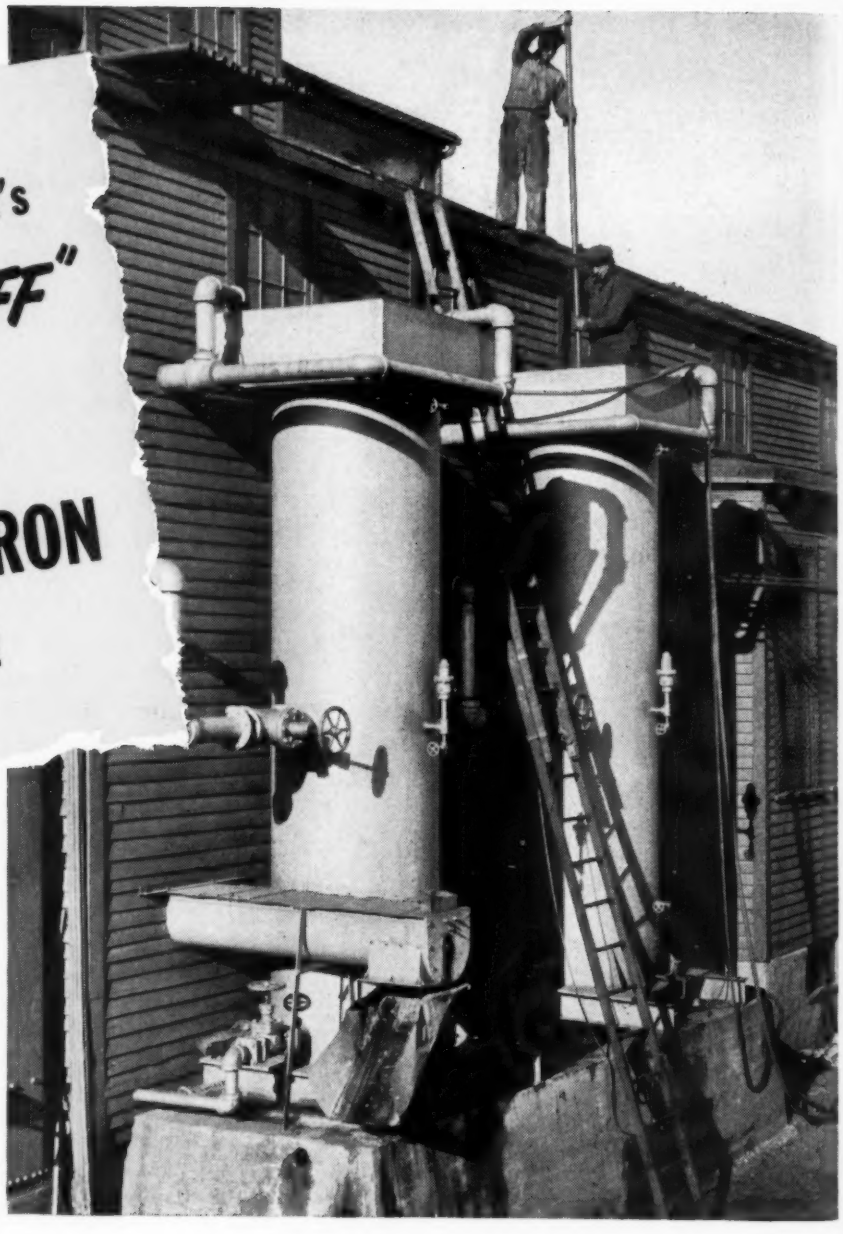
Elimination of unbalance vibrations is important to you. It means longer bearing life, smoother, quieter operation and fewer shut-downs for repairs. No power is wasted in destructive vibrations—it all goes to provide full power and efficiency.

ON WESTINGHOUSE TYPE C TURBINES

Steam Headquarters

WESTINGHOUSE

Here's a job that it's nice to "PUT OFF" and BYERS WROUGHT IRON helps do it!



When the engineers at the Willimansett (Mass.) plant of Hampden Brewing Company retubed a condenser recently, they took steps to postpone the next replacement as long as possible. Original tubing was low-first-cost material, which had given only eight years service. The new tubing is Byers Wrought Iron. Wrought iron had been used for repairing another condenser two years ago, which gave the engineers a chance to observe the performance of the material, and form conclusions as to its life.

Wrought iron has been used for so many years in so many different condenser installations that dozens of case histories are available. Because conditions vary widely, the life in each individual installation varies also; but all of the evidence indicates that wrought iron can be expected to last *longer*. In one study of a group of 32 condensers, the average life of the ordinary tubing used in 16 units was 8 years, while the average life of the wrought iron tubing in the remaining units was 19 years.

Wrought iron's unusual service qualities come from its unusual structure. Tiny fibers of glass-like silicate slag are threaded through the matrix of high-purity iron. These fibers halt and deflect corrosion, discouraging the pitting that generally causes ordinary materials to fail. The fibers also anchor the initial protective film, which provides a shield for the underlying metal.

Many have found it profitable to check on the possibility of using wrought iron *pipe* rather than tubing, because this often permits repair materials to be taken direct from plant stock. Standard pipe is available with outside diameters duplicating or approximating the OD of standard tubing sizes . . . and any differences can be easily taken care of by ferrules or reaming. One concern alone recently ordered 10,000 feet of black wrought iron pipe for retubing.

A number of different condenser installations are illustrated and described in our bulletin, "Wrought Iron in Refrigeration and Air Conditioning Systems," and if you have any new or repair jobs on condensers in prospect, you'll find the book well worth reading. May we send you a copy?

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Seattle, San Francisco.

CORROSION COSTS YOU MORE THAN WROUGHT IRON

BYERS

GENUINE WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE ALLOY STEELS • OPEN HEARTH ALLOY STEELS

CARBON STEEL TUBULAR PRODUCTS

POWER

PHILIP W SWAIN, EDITOR • MARCH 1945 • ESTABLISHED IN 1882

COAL CRISIS

THE NATIONAL COAL PILE is shrinking fast, and somebody's going to run short before the end of 1945. At best, millions of Americans will share the inconvenience. At worst, war production and war transportation will suffer.

Here are the over-all figures, checked by Solid Fuels Administration for War, for all bituminous coal and all types of coal users—industrial, utility, coke and steel production, railroad, domestic: Stockpiles fell from 64,020,000 tons on Dec 1, 1944, to 57,193,000 on Jan 1, 1945, and about 50,000,000 on Feb 1. By April 1 they will be down around 40,000,000—22 days' supply. Some piles will be above average, others dangerously below. Anything short of 30 days' average supply spells trouble.

Now let's step back and view the coal prospects for the entire year. Estimated coal needs for 1945 are 620,000,000 tons (same as actual use in 1944). SFAW says every means of increasing output per man-hour has been exhausted, and that mine labor will show a net loss of 30,000 men, mostly efficient young miners going into military service. Thus there is no good reason to expect 1945 production to exceed 580,000,000 tons.

Simple subtraction indicates a 40,000,000-ton deficit for the year, of which SFAW estimates that 15,000,000 might be sweated out of our starved stockpiles. The remaining 25,000,000 tons will be saved by wise economies, or at the expense of war production or war transportation.

Saving that 25,000,000 tons without blocking the war is the job ahead. The "brownout" of advertising signs and display lighting is barely a start—good only for 2,000,000 tons of coal. How about the remaining 23,000,000?

The power engineer must face the fact that he has more responsibility in this situation than any other individual outside the government. In industrial power plants, utility plants, large buildings, hotels and institutions, he burns around 200,000,000 tons of steam coal per year. Moreover, he is the only man who knows how to burn coal efficiently, so his duty in steam generation is clear.

But his contribution must go beyond that; steam saving is equally important. Here space heating economies hold the greatest promise.

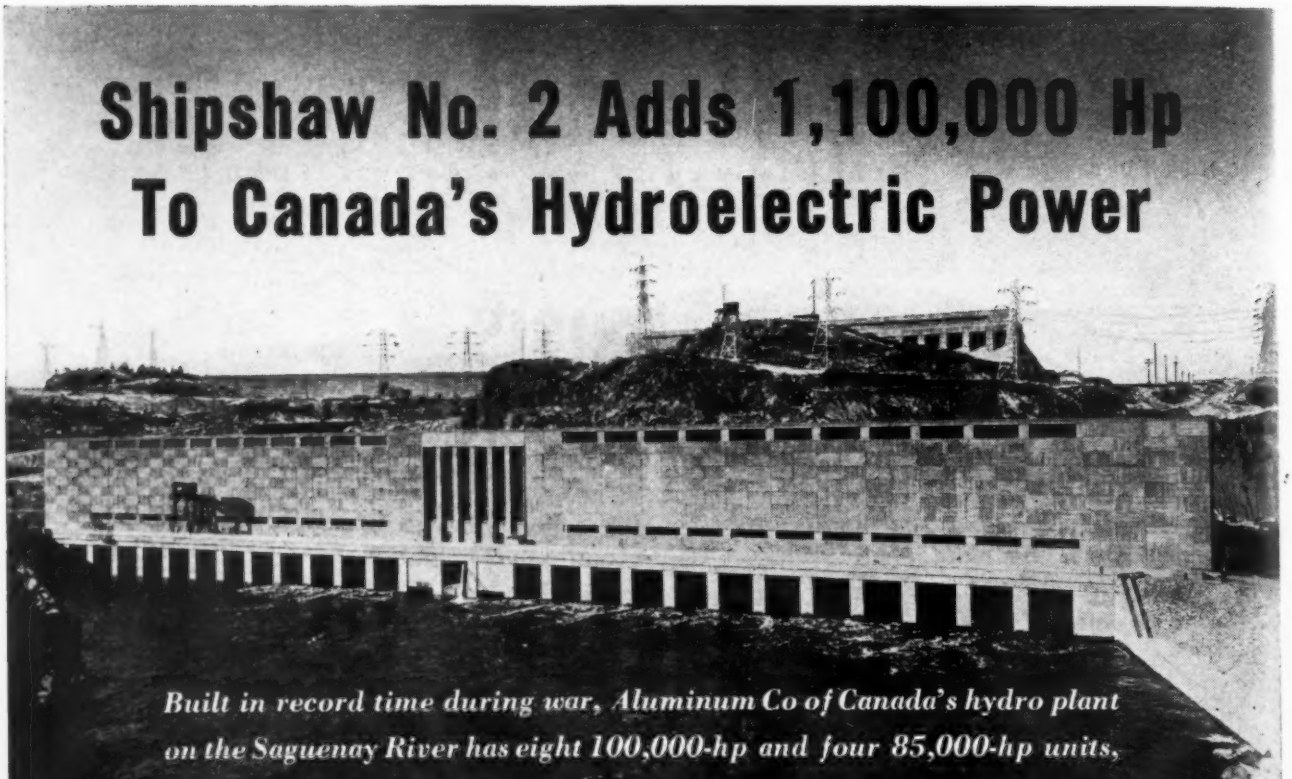
A large part of industrial steam coal, and practically all coal used in buildings and institutions, is for space heating, a joint responsibility of the power engineer and top management. All these establishments should immediately put a 68-F ceiling on comfort heating.

Finally, the engineer should look beyond his own plant in this matter of space heating, and use his influence to promote acceptance of 68 F as "wartime comfort" everywhere, including homes.

SFAW has estimated that a ten percent cut in heating coal will save 14,000,000 tons of coal yearly. Here is something worth fighting for.

NOTE: To promote fuel saving in factories, offices, public buildings and institutions we suggest the use of posters or bulletins like the sample on page 87.

Shipshaw No. 2 Adds 1,100,000 Hp To Canada's Hydroelectric Power



Built in record time during war, Aluminum Co of Canada's hydro plant on the Saguenay River has eight 100,000-hp and four 85,000-hp units, making it the world's highest-powered single plant. Turbines have 94.5%, generators 98.48% and transformers 99.38% test efficiency

► FROM LAKE ST. JOHN to tidewater the mighty Saguenay River in the province of Quebec rushes through rocky gorges. In a distance of 30 miles it falls 320 ft to provide one of the world's greatest sources of power. This section is now completely developed to produce nearly 2,000,000 hp in three great plants: Isle Maligne, Shipshaw No. 1 and Shipshaw No. 2. The latter is the chief concern of this article, based on papers in The Engineering Journal, Engineering Institute of Canada.

Water-Storage Capacity

Like many of Canada's great rivers, the Saguenay has tremendous natural storage in large lakes. Fig. 1 shows Lake St. John and part of its 30,000-sq-mi drainage area, mostly forest covered. With a 315-sq-mi area at low water and 415 at high, this lake provides 4,000,000 acre-ft storage in 15-ft drawdown. On the Grand Peribonka River, flowing into Lake St. John, one dam at Lake Manouan outlet and another at Passe Dangereuse provide 6,000,000 acre-ft additional storage. This 10,000,000 acre-ft of storage, augmented by the winter runoff, gives a regulated flow in the Saguenay of 44,000 cfs, equivalent to over 1,400,000 hp continuous.

Power development on the Saguenay dates back to 1900, but aside from making engineering studies nothing was done until Dec, 1922, when the Saguenay Power Co started work on the Isle Maligne plant. There was good reason for the delay because so mighty is the Saguenay in this section that only men who control great financial and engineering resources could develop it.

These men were Sir William Price of Canada and J B Duke of the United States, with William S Lee as chief engineer. To provide a temporary market for part of the power Sir William Price started construction on a paper mill to use 200,000 hp, about 75% of which would go into electric steam boilers.

Isle Maligne and Isle d'Alma divide the flow from Lake St. John into the Grand Discharge and Little Discharge. Isle Maligne plant is built across the Grand Discharge outlet, Fig. 1. It has 540,000 hp installed in twelve 45,000-hp units operating under a 110-ft head. Seven concrete spillways, one earth dam and the concrete powerhouse bulkhead comprise the hydraulic features of this development. They are located along the Grand and Little Discharge over a distance of seven miles.

Shipshaw No. 1 Plant

Before Isle Maligne project was ready for operation in 1925, plans were filed for complete development of the Saguenay by the Aluminum Co of America, who planned a large aluminum plant at a nearby site, now known as Arvida. First stage of this project was the building of a concrete dam across the Saguenay just above Chute a Caron with a powerhouse in the dam for four 65,000-hp units operating under a head of 155 ft. This plant, first called Chute a Caron, later became Shipshaw No. 1 and backed the water up the river 22 miles to Isle Maligne plant.

The business depression stopped work on the second stage, Shipshaw No. 2, until 1937 when the demand for aluminum indicated a need for more

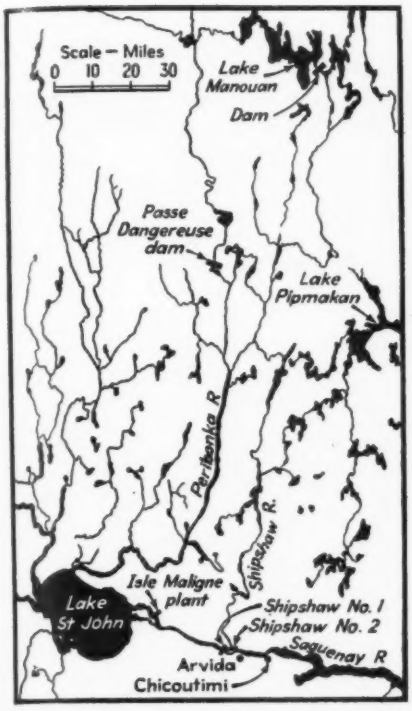


Fig. 1—Map shows part of the 30,000-sq-mi watershed draining into Lake St. John and location on the Saguenay River of the three hydroelectric power plants

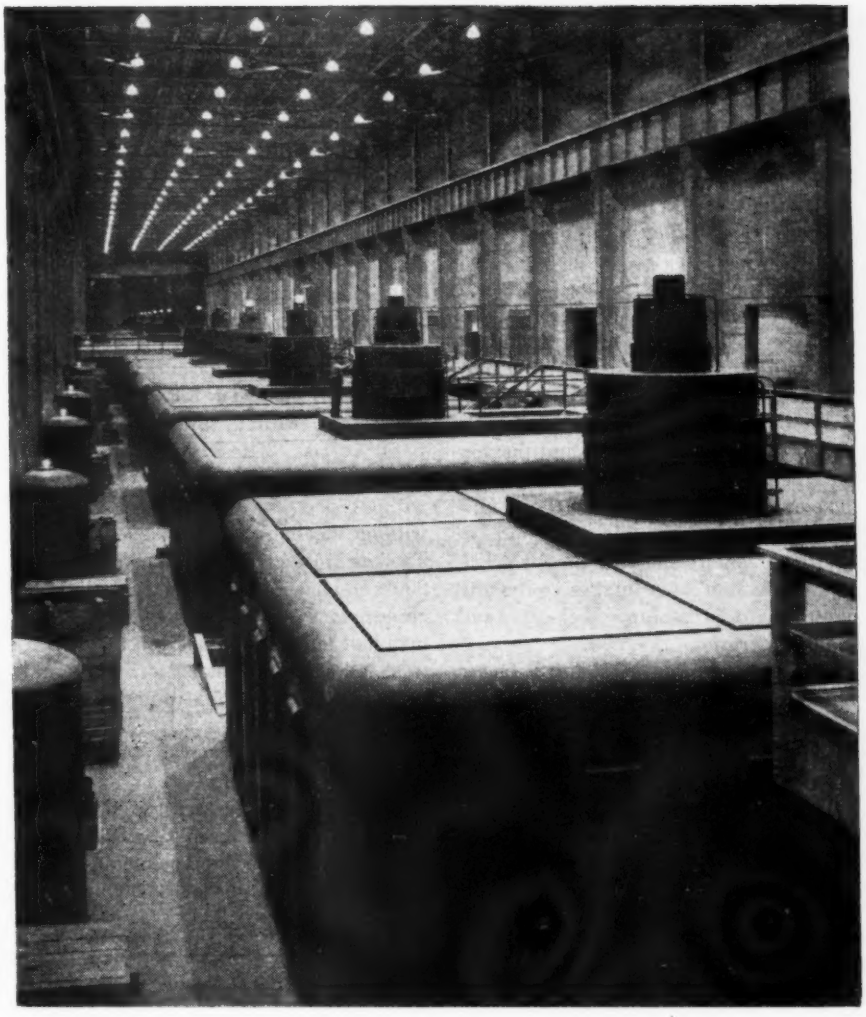


Fig. 2, *right*—Ten 75,000-kva and two 65,000-kva generators are cooled by air recirculated through coolers in each corner of a steel-plate housing 36 ft square. These twelve generators produced in Oct, 1944, 549,397,000 kwhr, equal to an average load of 990,000 hp for 31 days

power. The Chute a Caron power development and the power rights at Shipshaw were acquired by Aluminum Co of Canada, Ltd, and its assistant chief engineer, F L Lawton, began studies on how to obtain economically an additional 100,000 hp by a partial completion of the development. By 1940 it was apparent that 300,000 hp might soon be needed for aluminum production. Stone & Webster were engaged to make an up-to-date engineering study for completing the Shipshaw development. This report had just been completed when aluminum requirements became so large that H C Acres was employed in the fall of 1940 to make the final designs for a development of 250,000 hp that could expand readily to 1,000,000 hp.

By this time, because of the rapid increase in demand for aluminum, it was evident that additional power would be required before Shipshaw No. 2 could start operation. This condition was met by extending the Chute a Caron plant (now Shipshaw No. 1) to install two more 65,000-hp units, No. 5 and 6. Construction work on this project started April, 1941. On Feb 8, 1942, unit No. 5 delivered power and unit 6, less than two months later. These two units were later removed and were the 11th and 12th installed in Shipshaw No. 2.

Shipshaw No. 2 Plant

Fig. 4 shows the general layout of Shipshaw No. 2 development as constructed. Water is diverted from the Saguenay River by Shipshaw No. 1 (Chute a Caron) dam through a 7350-ft canal to a forebay. Six 30-ft-diameter concrete-lined tunnels connect the forebay headworks to the powerhouse near the Saguenay River, about one-half mile above the Shipshaw River mouth. Each tunnel connects to a steel wye with two 18-ft diameter branches. Short 18-ft diameter penstocks connect wye branches to eight 100,000-hp and four 85,000-hp turbines with plate-steel scroll case. All steel-plate work was field welded and embedded in reinforced concrete on solid rock. Average length of water passage from scroll case to forebay headworks is 740 ft.

Capacity and efficiency tests were made after sufficient units had been installed to permit taking one out of service without interfering with needed power production. The efficiency tests were made by the Gibson method in strict conformity with the test code. No. 8 unit developed 82,000 hp at best gate and 96,000 hp at full gate. This unit's operation was so smooth and free from vibration that the manufacturer agreed to increase the capacity of turbines still in the shop by cutting back the runner-bucket edges. It was estimated that cutting back the bucket inlet edges and grinding the outlet edges thinner would increase each turbine's capacity 8000 hp without reducing its maximum efficiency. It was therefore decided to experiment with two turbines, No. 9 and 10, still to be delivered. Buckets of No. 10 runner were ground on outlet edges only and No. 9 buckets were cut back on the inlet edges and ground on the outlet edges.

When tested, No. 10 unit developed 88,000 hp and 94.4% efficiency at best-gate opening and 101,360 hp and 85.3%

efficiency at full gate. Unit No. 9, with both edges of its buckets cut back, developed 86,000 hp and 94.5% efficiency at best gate, and 105,160 hp and 86.4% efficiency at full gate.

Smooth joints obtained by welding in the scroll cases and their steel-plate connections to the penstock tunnels undoubtedly contributed to the high efficiency of the turbines. Other factors are the excellent hydraulic design of the waterways. Penstocks are practically horizontal and without bends for a long distance upstream from the turbines. Only source of possible water disturbance is the wye connections and the vertical bend in the tunnels. These are sufficiently far away so that any disturbance they cause is smoothed out before water enters the turbines. Experience shows that such intakes contribute materially to turbine efficiency and smooth operation.

Draft-tube design is a third factor contributing to performance of turbines. As shown in Fig. 3, they have a square-heeled elbow with a vertical length of 44 ft 6 in., from distributor center line to draft-tube bottom. This length and a runner discharge diameter of 13 ft, 8 in. gives a length ratio of 3.26 times runner-discharge diameter. Horizontal draft-tube length from turbine vertical center line to powerhouse downstream wall is 49 ft, giving 3.6 length to diameter ratio. Draft-tube free-discharge width, including one center pier, is 47 ft to give a width ratio 3.44 times runner discharge diameter. These ratios are liberal and are another factor in favor of the excellent turbine performance.

Vertical Generators

Ten turbines connect to 75,000-kva 13,200-v 0.80-pf 3-phase (eight circuits per phase) 60-cycle 128.6-rpm 56-pole generators, with a full-load 60-C temperature rise. These generators are so designed that they can run continuously without load or without field at 244 rpm without mechanical or electrical injury. Two turbines connect to 65,000-kva 13,200-v 3-phase generators. These machines were, as previously mentioned, installed temporarily at Shipshaw No. 1 to meet earlier demand for additional power. They have extra-powerful exciters and can operate at 0.75 pf. They were rebuilt and provided with a new 56-pole rotor to operate at 128.6 rpm to agree with the other ten machines.

The generators rated at 75,000 kva have been operated under summer conditions at an output of 83,000 kva at 0.83 pf with a temperature rise above ambient air of 55 C for coils and 35 C for iron. These generators are expected to operate at 85,000 kva without exceeding 60-C temperatures rise. The generators rated at 65,000 kva have been operated at 69,000 kva at 0.74 pf with a temperature rise above ambient air of 44 C for coils and 29 for iron, and are expected to generate 75,000 kva without exceeding 60-C temperature rise. In October, 1944, Shipshaw No. 2 plant generated 549,397,000 kwhr, an average 24-hr load for each day in the month of 990,000 hp.

The two smaller machines have stators of slightly less diameter than the 75,000-kva units, but from their base ring to the pilot exciter top they are four feet higher. To make them the same height as the larger machines their base rings were set four feet lower by shortening the turbine shaft four feet. This was done by cutting the required amount from the generator end of each shaft and shrinking and keying a new cast-steel coupling to it. Possibility of welding a new coupling to the shortened shafts was abandoned because of the distortion hazard as welding had never been attempted on a shaft 35 in. in diameter.

Each generator has a directly con-

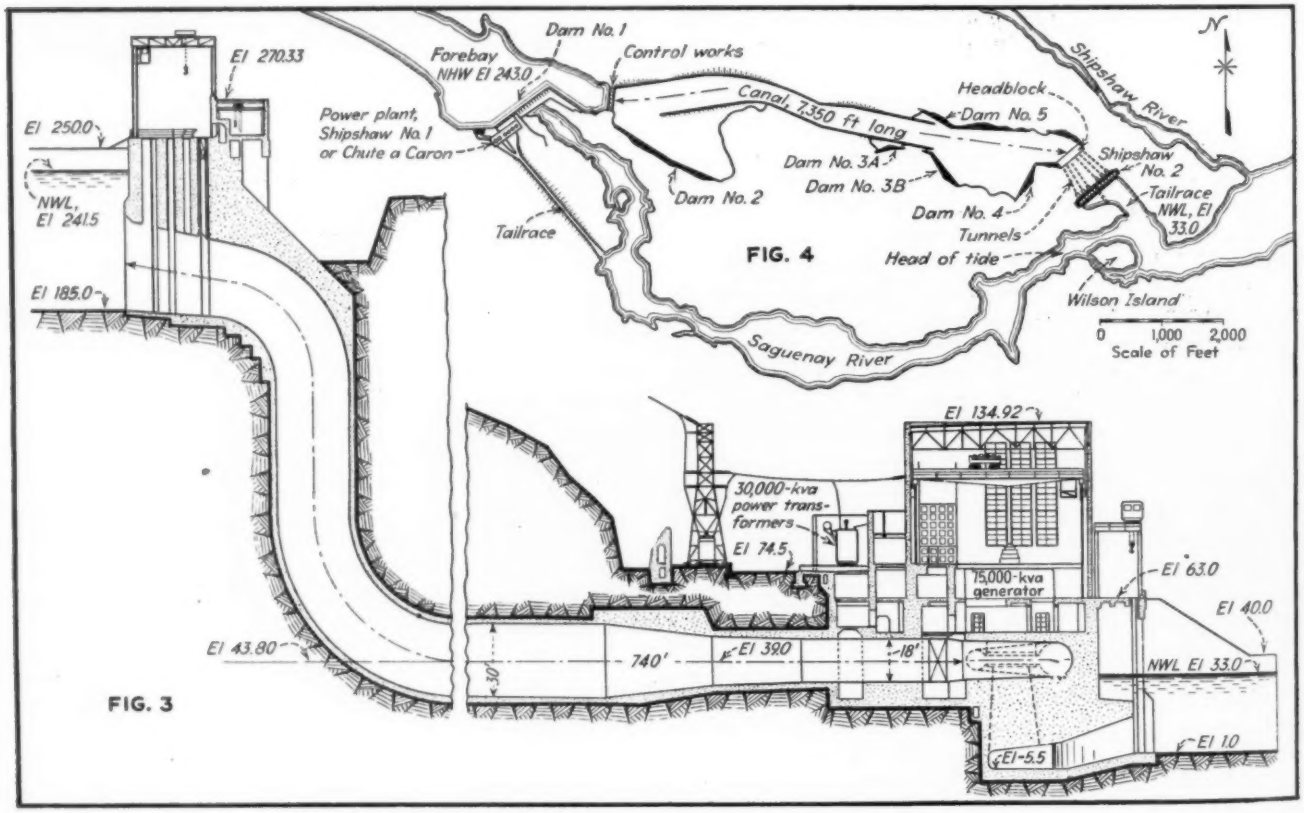


Fig. 3—From the forebay headworks, six 30-ft circular concrete-lined tunnels conduct water to a spot near the plant. Here they branch to steel-plate wyes and penstocks 18 ft in diameter for connection to twelve turbines with all-welded steel-plate scroll cases. Fig. 4—Layout of Shipshaw No. 2 hydroelectric project as constructed. Water is diverted from the Saguenay by No. 1 dam (sometimes called Chute a Caron) through a 7350-ft canal to a forebay above the powerhouse

nected main exciter and a 250-v pilot exciter and is designed to operate without a main field rheostat, but has a main exciter motor-operated field rheostat. All generators are totally inclosed in square steel housings with vertical ventilating-air surface water coolers in each corner.

The larger machines were designed for about 150,000 cu ft of cooling air per minute and the two smaller machines for 135,000. Because of the complications in providing sufficient duct capacity for these air volumes the generators were inclosed and a recirculating cooling system used. By eliminating the duct system, savings in powerhouse cost balanced the cost of generator housings and coolers and provided increased generator capacity because of lower operating temperatures.

Generator Housings

Generator housing provides easy access to the machine's electrical parts. Top of each housing is divided into nine squares. The center one supports the exciters; the others are moveable. One section next to the station gallery gives access to the thrust-bearing deck and exciter platform stairway. The other hatch covers drop into troughs in the edges of the opening, have no fastenings, and when lifted out expose all interior operating parts. Removal of corner hatches uncovers the air coolers. These can be cleaned in position by removing their top covers or serviced by lifting them from the housing.

Steel ladders in vertical air ducts run from the turbine floor to the generator frame top. Inside, the machine inclosure is painted cream color and illuminated. Whether a machine is running or not an operator can climb up the vertical ladders to its top to make inspections at any time without removing the top hatches.

Each 75,000-kva 13,200-v generator connects directly to a 90,000-kva bank of three transformers grouped delta-Y to step up to 154,000 v. High-voltage leads of the transformer connect through a 2,500,000-kva rupturing-capacity oil circuit breaker to a transmission line. Connections between generator and transformer are made with two 5-in. copper channels per phase clamped in box form with expansion joints in long horizontal runs. Generators of two different manufacturers have a full-load (75,000 kw at 1.00 pf) efficiency of 98.48 and 97.98%, respectively, and full-load transformer efficiency is 99.27%, with a maximum of 99.38% at 50% load.

Shipshaw's excellent performance bears high tribute to executives, engineers, contractors and everyone else responsible for the project. In spite of the stress of war and the difficulties of securing labor, materials and equipment promptly, the whole project was carried through to successful completion in record time. It stands as a monument to engineering achievement and is one of Canada's major contributions to production for World War II.

Engineering Work

All engineering work on the project was directly in charge of H G Acres & Co, consulting engineers, cooperating with McNeely DuBose, vice-president, and F L Lawton, assistant chief engineer, Aluminum Co of Canada, and R A H Hayes, acting chief engineer, Aluminum Laboratories, Ltd. Foundation Co of Canada were the general contractors, and Canadian Comstock Co were contractors for all electrical equipment not bought under installed contract. Canadian General Electric Co, Canadian Westinghouse Co, English Electric Co of Canada, Canadian Allis-Chalmers Ltd, and S Morgan Smith of Canada supplied the major equipment bought under installed contract.

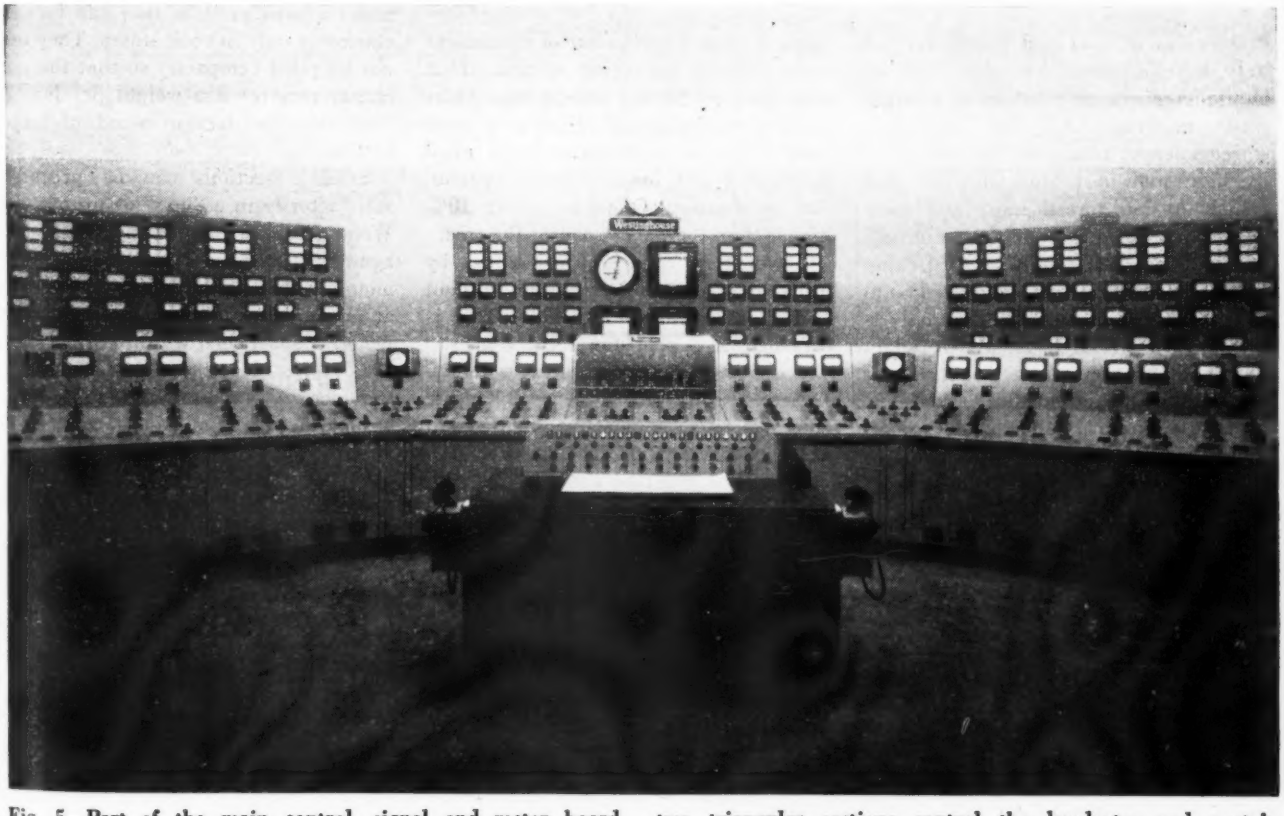
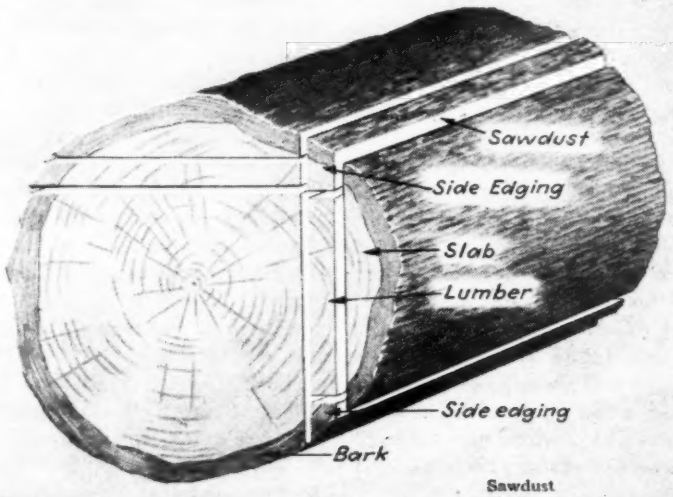


Fig. 5—Part of the main control, signal and meter board. Operator's desk in foreground containing signal system for each generator is surrounded by a bench board from which the twelve generators and the headgates are controlled. The two triangular sections control the headgates and contain swivel synchroscopes. The annunciator in the center section contains 22 protective signals for each generator. Two 6-panel voltage-regulator switchboards do not show in this photograph

ABC's OF WOOD FUEL



Sawdust	12.8%
Bark	11.3
Shavings	7.9
Small slab and edgings	8.1
Large slab and edgings	3.7
Trim and ends	5.1
Total mill waste	48.9%
To lumber	51.1%

Fig. 1—Average sawmill practice for fir logs shows about half of the total weight of log is byproduct fuel source

Sawdust, hogged fuel and chips are useful byproducts. R B Boals, mechanical engineer for Eugene, Oregon, Water Board, details basic fundamentals of woodburning

► Deposits of coal and petroleum are only accumulations of what the inhabitants of earth must have thought waste material. All fuel represents stored energy from growths stimulated by light and heat from the sun and water. As our forests more and more become an agricultural "timber crop," we are concerned chiefly with utilizing that portion of it not converted into salable lumber at the mill. Not only is this waste material a useful byproduct but, if left to accumulate, it constitutes an enduring and serious fire hazard.

Manufacture of lumber from a log requires removal of bark and as much wood as is necessary for producing clear square-edged pieces. Major portion of burnable waste comes from operations indicated in Fig. 1. The amount of sawdust varies with type of saw used and dimensions of lumber on order because more cuts are made to produce small sections. Material removed from the rough lumber in the planing mill is classified as shavings. Average sawmill operations, according to a study by Professor Glenn Voorheis (Bulletin No. 17, 1942, Oregon State Experiment Station) yield about half lumber and half wastes, Fig. 1.

Part of the bark drops from the log in pond or transit and is out of convenient reach of mill conveying system. That remaining on the log accompanies slabs to their final disposal. Bark is a good fuel. It burns more slowly than wood because it has lower volatile content, but its heating value is about 10% higher than the body wood of the tree.

Sawdust is often self-consumed by mills in their boiler plants without further preparation although some is screened and sold for local domestic use. Mills use either sawdust or a mixture of sawdust and shavings for steam fuel. There is comparatively little market for shavings because of their low density, low moisture content and their characteristic quality of not "feeding" well in small burners. Mills that burn shavings have a correspondingly greater amount of sawdust to sell.

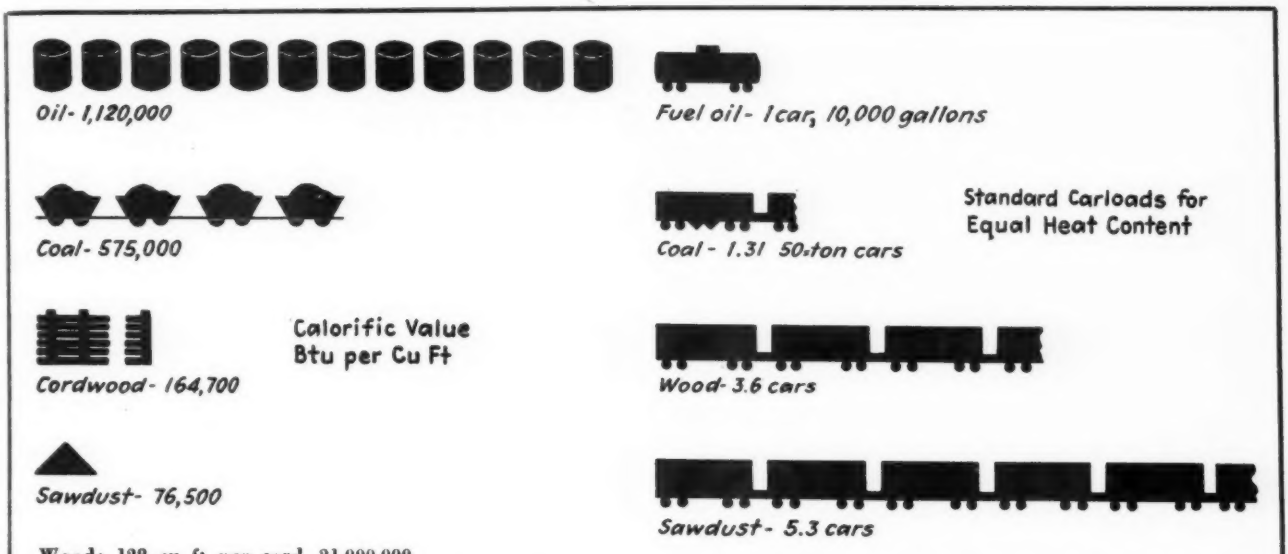
Light slabs and edgings were formerly disposed of by burning them at the mill. Small-dimensioned sticks do not command a good price as they can be used efficiently only in cook stoves. They cannot be piled compactly so that the purchaser receives less weight per load or cord than he does of wood of larger section.

Smaller sections can be processed satisfactorily in a "hog" of proper size. Wood pieces fed into the hog are held against a stationary anvil while knives mounted on cone-shaped rotors cut chips at an angle with the grain much as a pencil is sharpened with a knife. "Chippers" have blades mounted radially on the face of a rotating flat disk to cut across the grain of wood fed at right angles to the disk. Hogged fuel and chips are the products of these devices. Sawdust is frequently mixed with

Table I—Conventional Wood-Fuel Analysis by Weight

	Proximate		Chemical	
	Wet fuel	Dry fuel		Dry fuel
Moisture	46.8%	0%	Carbon	50.3
Volatile	44.0	82.6	Hydrogen	6.2
Fixed carbon	9.0	17.0	Oxygen	43.1
Ash	0.2	0.4	Nitrogen	0.04
Btu per lb	4750	8970	Ash	0.37

Note: All woods have substantially the same chemical analysis but may vary considerably in density



Wood: 128 cu ft per cord, 21,000,000 Btu. Sawdust: 200-cu-ft unit, 15,300,000 Btu. Coal: 50 lb per cu ft, 11,500 Btu per lb. Oil: 150,000 Btu per gal

Fig. 2—Many more cars are required to haul equal Btu's as wood fuel than either oil or coal so that transportation for long distances is uneconomical. Much of byproduct wood supply is normally consumed in or near plant of origin

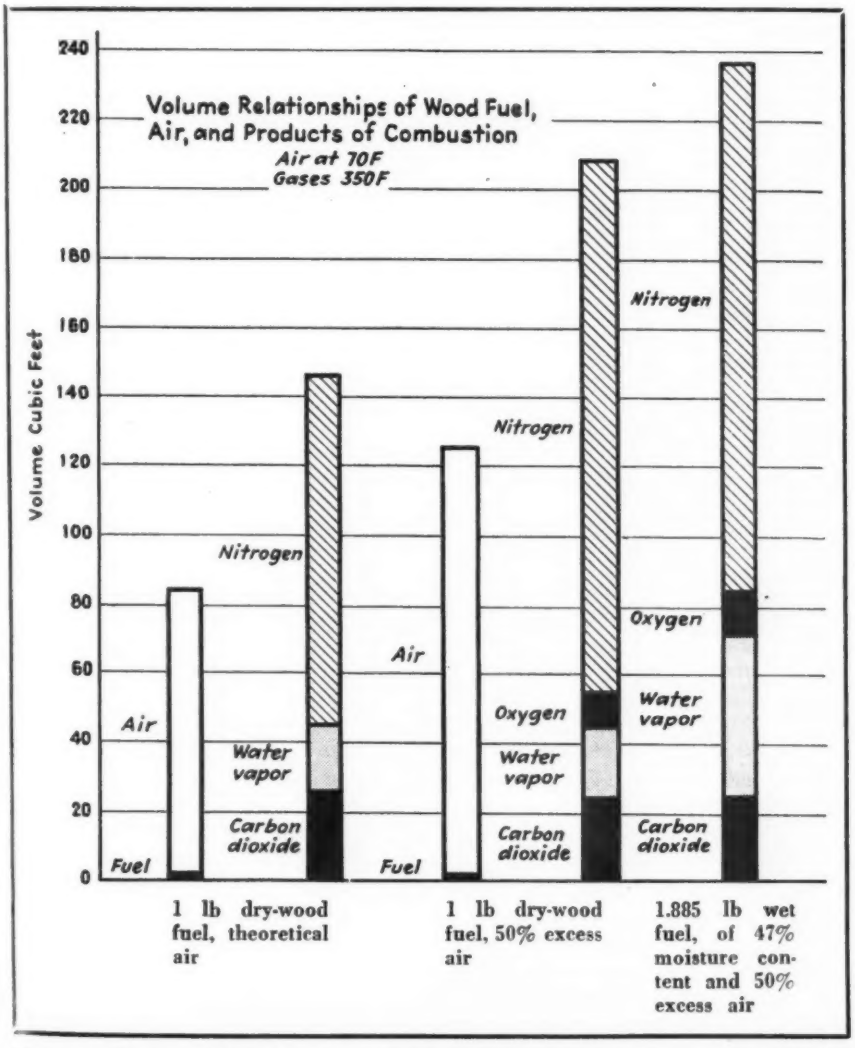


Fig. 3—Volume relationship of combustion air and flue gas for wood fuel with 47% moisture and 50% excess air, assuming inlet air at 70 F and exit gas at 350 F

hogged fuel and always added to chips. The resulting mixtures weigh more than without sawdust and have better feeding qualities.

Large slabs and edgings are commonly marketed in 16- or 48-in. lengths under the name, heavy slab. The market determines its disposition, whether cut to specified length, hogged or destroyed in a trash burner.

Mill trim consists of short random lengths, which result from cutting to length and grading of manufactured lumber. Planer ends are trimmings from finished kiln-dried lumber used only for kindling.

Fuel Analysis

As for other solid fuels, physical characteristics of wood are conventionally given by the proximate analysis, Table I, which includes moisture, volatile, fixed carbon and ash as percentages by weight. Heating value in Btu per lb is usually reported on both "as received" and "dry" basis.

Moisture content is determined by maintaining a sample at 220 F in an oven until the weight becomes constant. Moisture (1) contributes nothing to the calorific value of the fuel (2) adds to the weight and cost of transportation (3) requires about 1200 Btu per lb of moisture to raise its temperature to vaporization point, evaporate it and superheat it to boiler exit temperature.

Volatile matter is distilled from a sample in a covered crucible at 1750 F (or lower as specified). Flame appears around the cover after about one minute

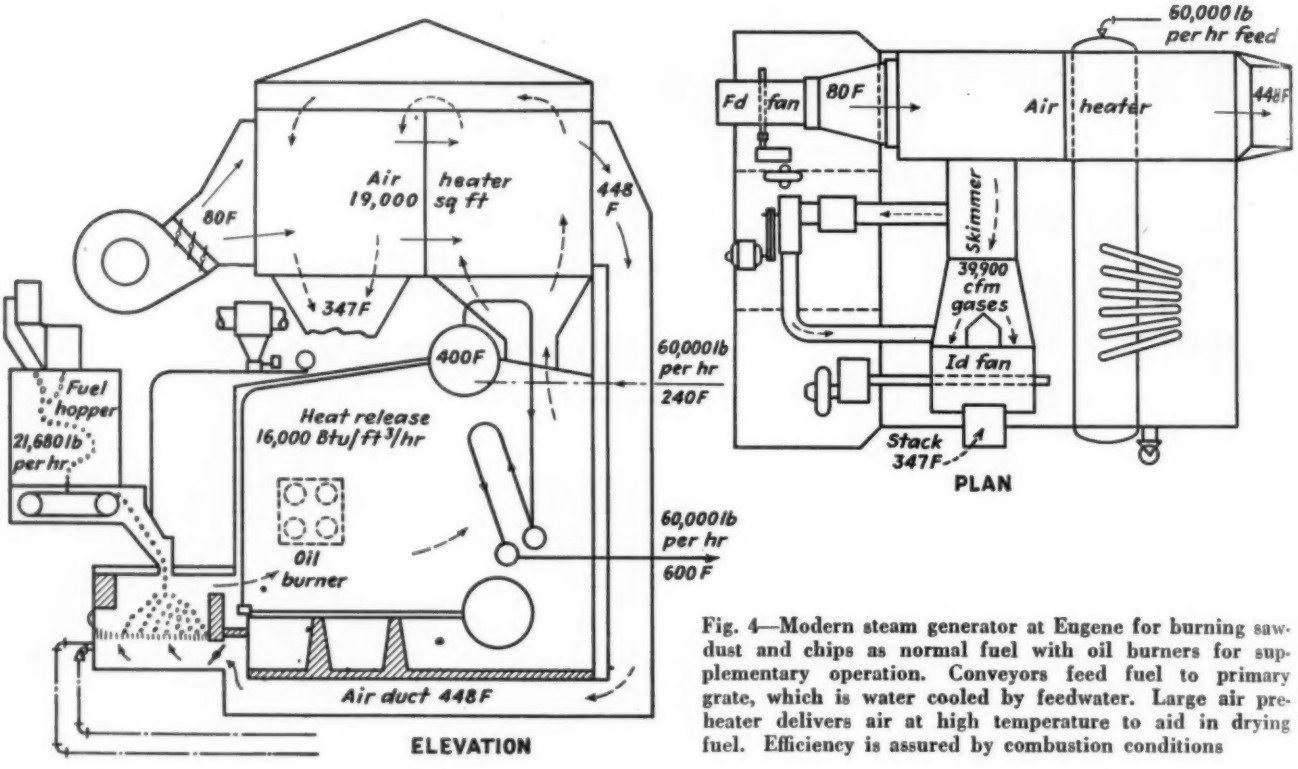


Fig. 4—Modern steam generator at Eugene for burning sawdust and chips as normal fuel with oil burners for supplementary operation. Conveyors feed fuel to primary grate, which is water cooled by feedwater. Large air preheater delivers air at high temperature to aid in drying fuel. Efficiency is assured by combustion conditions

of heating and burns for another minute or so after which the sample is kept at temperature for another seven minutes. Volatiles account for more than two thirds of the heating value of wood and require about 60% of the theoretical air for combustion.

Fixed carbon (charcoal) remains after the volatile has been driven off. It represents the remainder of available heating value. Ash content of wood is very small, only a fraction of one percent of the total weight.

Best Combustion

Chemical analysis, Table I, shows proportion by weight of carbon, hydrogen, oxygen, sulphur, nitrogen and ash in a fuel. There are but three combustible elements in any fuel, carbon, hydrogen and sulphur. Since wood contains no sulphur, this item does not appear in Table I.

Proximate analysis of a fuel indicates how it is best burned. Chemical analysis is needed to compute heat value, weight and volume required for combustion, and weight and volume of products of combustion.

Total theoretical air requirement for wood is about 6 lb per lb of dry wood. Actual quantities, of course, should allow for sufficient excess air to complete combustion of the volatiles and should also take account of prevailing moisture content of the wood. Fig. 3 indicates volumes required in cubic feet per lb of dry wood.

Wood kindles at some temperature between 750 and 1000 F. Distillation of moisture proceeds at lower temperatures but no flame appears. Steps in the combustion of wood can be summed up as follows: (1) drying, which proceeds rapidly at the surface but which requires time to reach interior parts of larger pieces (2) distillation and burning of volatile matter (3) burning of fixed carbon at a definitely limited rate.

Temperature in the furnace or combustion zone must remain above kindling point or combustion ceases. Furnace temperature depends on calorific value of the fuel, moisture content of fuel, weight of air flowing through the fuel bed, and heat loss from flame and fuel bed by radiation. High furnace temperature promotes rapid burning and is in itself one indication of good combustion.

In furnaces designed for wood fuels, gas velocities seldom exceed 25 ft per sec and the time available for burning a given particle above the fuel bed is half a second or more. For efficient combustion of volatiles, gas must move slowly enough or have a long enough path so that burning is complete before the gas is chilled below kindling temperature. As the proportion of excess air is cut down to improve efficiency the time element becomes more important because of reduced chances for free oxygen molecules to mix with unburned gas.

In considering the combustion of wood, one should carefully review the characteristics of a household fireplace. The heat reflected from the masonry back to the burning fuel is important to the combustion process, sustaining temperature well above the kindling point. Comparatively large pieces of dry wood are customarily used in fireplaces; heat penetration is slow so that volatiles are still being released while fixed carbon is being consumed at the surface. The smaller the individual pieces of wood, the faster the release of volatiles and the shorter the total burning time.

Sawdust Fuel

Thus sawdust has proved an entirely satisfactory fuel for steam boilers. It is already in a finely divided state so that combustion proceeds rapidly. There is never any considerable quantity of fuel in the burning zone. Fuel can be introduced by gravity or any type of automatic feed. If the burning zone is reasonably well shielded from radiation loss to cold surfaces, good burning conditions can be maintained under low load or banked conditions as well as higher rates of fuel feed.

Fig. 5 shows a modern 60,000-lb-per-hr 250-psi boiler installation adapted to wood-waste fuel. Preheated air aids in drying the fuel which is fed from a hopper into a refractory-lined chamber by three feeder conveyors through chutes that are substantially air tight. Grates are water cooled, the heat absorbed being returned to the boiler feedwater.

Amines Check Corrosion In Condensate Return Lines

Maximum effect comes from continuous feeding of a compound volatilizing completely at operating temperature. Guard against excessive, costly loss from vents and blowdowns*

▶ CORROSION of piping for steam heating comes mainly from oxygen and carbon dioxide (CO_2) dissolved in condensate. Scattered pitting usually indicates oxygen corrosion. But CO_2 makes condensate acidic so that it dissolves metal more uniformly and produces initial failure at threaded joints where piping is relatively thin. Surfaces of heaters, radiators and traps are especially vulnerable because they are exposed to newly condensed steam. As an added nuisance, solid corrosion products accumulate and plug the return lines. CO_2 enters with feedwater, generally as carbonates and bicarbonates, whereas oxygen not only enters with feedwater but also with air that leaks into lines under partial vacuum.

Natural water sometimes contains both free and combined CO_2 as carbonates and bicarbonates. In addition, sodium carbonate is often added with boiler-water-treating chemicals. Heated at boiling temperatures, bicarbonates, and to a large extent carbonates, decompose and gaseous CO_2 leaves the water with the steam. Condensate from steam containing CO_2 tends to dissolve the gas until equilibrium is reached with that remaining in the vapor. In the absence of alkaline carryover, CO_2 is present both in the free state and as carbonic acid.

Poorly vented equipment accumulates the gas and, as a result, the condensate contacts an especially high concentration of CO_2 and can dissolve much of it. Net result is channeling of the nipples and often of adjacent piping. In the return pipe smaller concentration of CO_2 in the vapor reduces both the CO_2 dissolved in the condensate and resulting corrosion.

Condensate containing alkaline carryover can dissolve additional CO_2 because part of the gas reacts with the alkali to form bicarbonates. Then only the remaining free CO_2 in the water is in equilibrium with residual gas in the steam. With sufficient alkali carryover essentially all of the gas may be converted to carbonates so that little carbonic acid remains to corrode the metal. In general, such water is almost neutral or has a pH close to 7.0.

Certain amines have been offered as having practical value to prevent condensate corrosion in the belief that they volatilize from boiler water and neutralize the carbon dioxide. These chemicals are compounds in which an organic group is substituted for one or more hydrogen atoms of the ammonia molecule. Some of the simpler amines are soluble in water and volatilize from steaming water.

Dissolves CO_2

To prevent corrosion, amines act like alkaline carryover leaving little or no free CO_2 in the condensate. Hence it appears that if enough amine is supplied continuously to provide a condensate pH of 7.0, corrosion can be controlled. Experience is the best guide to room-temperature alkalinity at which to maintain condensate. Excessive use of amines is not only expensive but may lead to undesirable reactions on valve metal and packing.

The ideal amine is alkaline and volatile with steam from boiler water. When steam condenses, the amine dissolves in the condensate and neutralizes the carbonic acid. Presumably the neutral or alkaline condensate is then less corrosive. Caustic soda in boiler water, being a stronger alkali than the

* Abstracted from U. S. Bureau of Mines Report of Investigations 3754

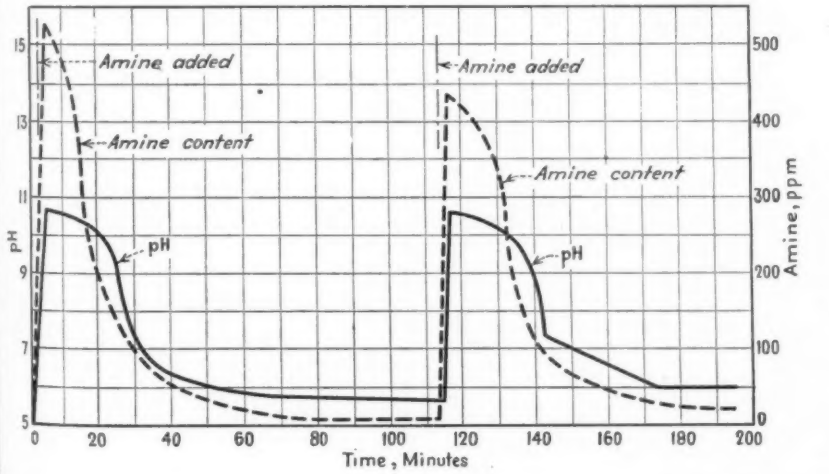


Fig. 1—The pH and amine concentration of the steam increased sharply after each addition of compound, but tapered off in the 3-hr period after initial treatment

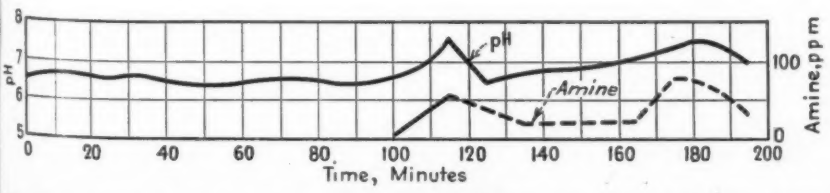


Fig. 2—No amine was found in the return until almost 2 hr after the first treatment because condensate containing the newly added amine returned intermittently

amine, would release the latter to recirculate with the steam. When plant makeup water adds comparatively little CO_2 to steam, the ideal amine can be quite useful without excessive cost.

Without amine treatment, CO_2 in the condensate is mostly free, and in this state prevents further solution of the much larger quantity remaining in steam spaces. Uncondensed gas is usually vented, and some of the CO_2 already dissolved may afterward be lost when the condensate passes through flash tanks. Only a small portion of the CO_2 returns to the boiler.

On the other hand, when an amine produces an alkaline condensate, the free CO_2 is neutralized, and the time factor is the only barrier to complete solution of all CO_2 in the steam. Consequently enough amine must be used to neutralize both the CO_2 normally present in the condensate and that in the steam. With all CO_2 fixed as amine bicarbonate in the condensate, both CO_2 and amine return to the boiler feedwater. Ordinarily little of this CO_2 is driven off in the feedwater heater.

Amine Conductivity

Normally condensate is a poor conductor of electricity. Any increase in its conductivity tends to favor corrosion since the process is considered essentially electrochemical. This may be especially true of oxygen corrosion. Therefore remember that amine bicarbonate in the condensate greatly increases its conductivity. Even though certain amines markedly decrease return-line corrosion, the condensate in many such systems is acid most of the time. Therefore the quantity of amines to inhibit corrosion may be much less than that to neutralize the carbonic acid completely.

Cyclohexylamine, one of the principal amines for alkalizing steam condensate, is an organic compound in which the cyclohexyl group substitutes for one of the hydrogen atoms of ammonia.

The pure amine is a water-white liquid with a strong, fishy odor. It boils at 276 F but has the peculiar property of forming with water a mixture that boils at 206 F. The compound must be handled with care because the vapors are inflammable and in the concentrated state it may produce skin sores. Water solutions of cyclohexylamine are alkaline. The amine is more strongly basic than carbonic acid is acidic so that when chemical equivalents of the two are mixed the amine bicarbonate formed is slightly alkaline (pH 8.1).

Cyclohexylamine treatment should prevent return-line corrosion if enough amine is introduced into the steam system to maintain the condensate at a minimum pH of 7.0, measured at room temperature.

To alkalize the condensate properly by cyclohexylamine the amine must be sufficiently volatile to enter the main with the steam and CO_2. Preliminary

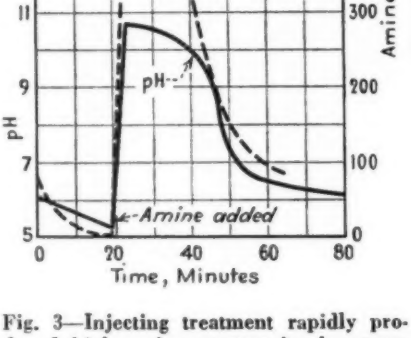


Fig. 3—Injecting treatment rapidly produced high amine content in the steam

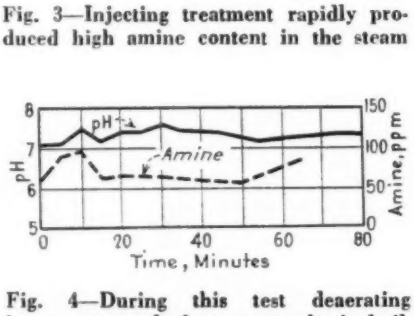


Fig. 4—During this test deaerating heater operated above atmospheric boiling point and gave better CO_2 removal

studies showed that it completely votalizes in a short time from a boiling alkaline solution. Continued experiments determined amine concentrate at several points in steam-heating system supplied by a 1000-sq-ft Wickes boiler, while cyclohexylamine was fed to produce alkalinity in the condensate return. Steam is generated at 100 psi, but is used directly at this pressure only in certain heaters, other buildings being equipped with individual pressure reducer, safety valve, traps and flash tanks. Most of the latter are vented.

Condensate from the flash tanks goes to central collecting tanks from which it is pumped intermittently to the boiler room. Here, condensate enters a 1000-gal storage tank mounted above the deaerating heater. When tank water level drops to one third full, cold, untreated well water containing 45 ppm of free CO_2 and 300 ppm of calcium bicarbonate is introduced automatically. Makeup requires a minimum of 2000 gal per day. A float valve in the feedwater heater regulates water flow from the tank. Steam to the heater was maintained at 4-psi backpressure.

Feed pumps supply deaerated water to the boiler according to steam demand. A special connection to the pump intake permitted introducing directly to the boiler a 60% chemical solution proportioned to suit the water flow. The boiler, internally treated with metaphosphate and quebracho extract, is blown down when the water contains more than 3000 ppm dissolved solids. Boiler water usually contains a hydroxide concentration of about 100 ppm OH, a phosphate concentration of about 30 ppm PO_4 and a definite tannin color.

Sampling Points

Condensate was sampled at the vertical pipe leading to the main storage tank, and steam at the auxiliary steam header. Piping arrangement permitted sampling the vapor leaving deaerating-heater vent. A steam sample was also taken 1100 ft from the boiler room from a low-pressure pipe. All samples were taken through copper cooling coils and, to prevent stagnancy, a small continuous stream was discharged to waste at each point during the run.

Tests were begun 15 min before amine was added and samples were drawn from the condensate and the two steam sampling points at 5-min intervals. Three vapor samples from the deaerating-heater vent were taken at 15-min intervals. A sample of boiler water was taken 30 min after adding the amine. Ordinarily tests ran 84 min.

Fig. 1 shows how steam pH and amine concentration leaving the boiler varied through the 3-hr period following initial treatment. The two additions of one quart each of 60%-amine solution caused almost instantaneous rise in the curves. First treatment kept the steam alkaline for about 30 min; the second, for about 35 min. That amine entered the boiler more slowly during the second injection is confirmed by the substantially lower maximum concentration.

Fig. 2 shows how pH and amine concentration built up in the condensate during the same 3-hr period. No amine

was found in the return until almost two hours after the first treatment because condensate containing the newly added amine returned intermittently.

Fig. 3 indicates variation of pH and amine concentration in the steam during the first run under stabilized conditions. Feedwater pumps were stopped 10 to 15 min before amine was added, and its concentration in the steam dropped to zero. A rapid injection of treatment then resulted in the unusually high amine concentration of 660 ppm in the steam, condensate remaining alkaline about 30 min.

Condensate pH during this run was between 7.2 and 7.6, Fig. 4. Amine concentration was between 60 and 100 ppm, while total CO_2 (free and combined) in three determinations averaged 34 ppm. Previous to this run the deaerating heater was cleaned and arranged for operation at temperatures above the atmospheric boiling point, making possible better CO_2 removal.

Adding one quart of 60%-amine solution affected the pH and amine concentrations in the steam at both sampling points when the condensate pH had been adjusted to pH 8.3, Fig. 5. Higher total CO_2 concentrations in the low-pressure steam (1100 ft from the boiler) may indicate CO_2 pockets in the steam line. Or it is possible that only a fraction of CO_2 in the steam is condensed with the sample and that at low pressure (10 psi), conditions may be more favorable for condensing.

Amine with pH 9.1

Fig. 6 shows variations in the alkalinity and amine concentration of the steam caused by adding amine to the system when condensate returns were adjusted to pH 9.1. Amine concentration and alkalinity variations were similar to those for previous runs. Even though the condensate's amine content was relatively high in this run, steam samples were alkaline for only a comparatively short time immediately after adding makeup amine to the boiler.

Fig. 7 compares the return condensate of Fig. 6 with that of a test for which the deaerating-heater temperature was lowered to below 210 F. On the average, amine concentration in the samples was somewhat higher during the latter test. Total CO_2 content was 30% higher, however, and pH was therefore considerably lower. Amine additions before and during the two runs were the same. Analysis of the vented vapors from the deaerating heater showed that little change occurred in the amount of amine driven off, but that much less CO_2 was removed when the heater temperature was below atmospheric boiling point.

Boiler-water samples, taken at various times after raw makeup was added, contained little or no amine. Concen-

(*Continued on page* 146)

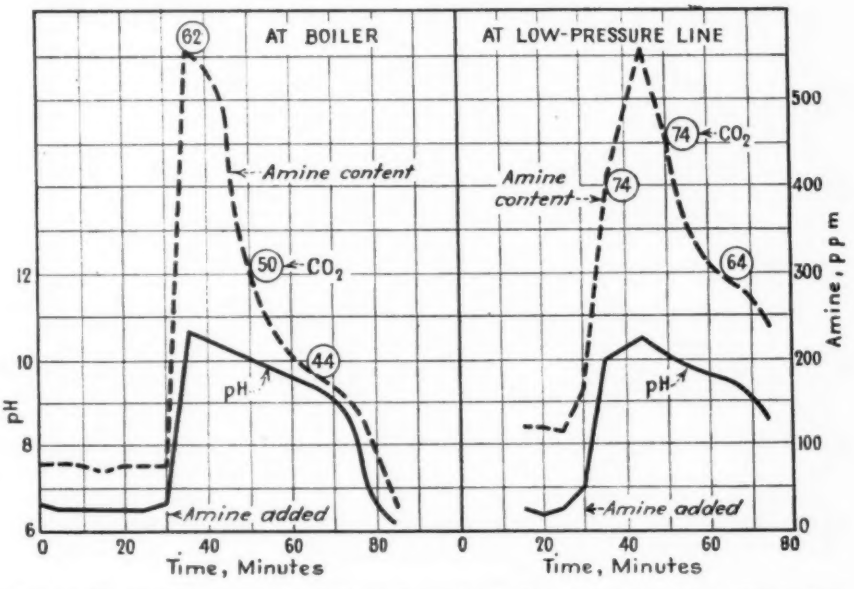


Fig. 5—Higher CO_2 at a point 1100 ft from the boiler indicates either CO_2 pockets in the line or that low pressure may favor CO_2 condensation in the test sample

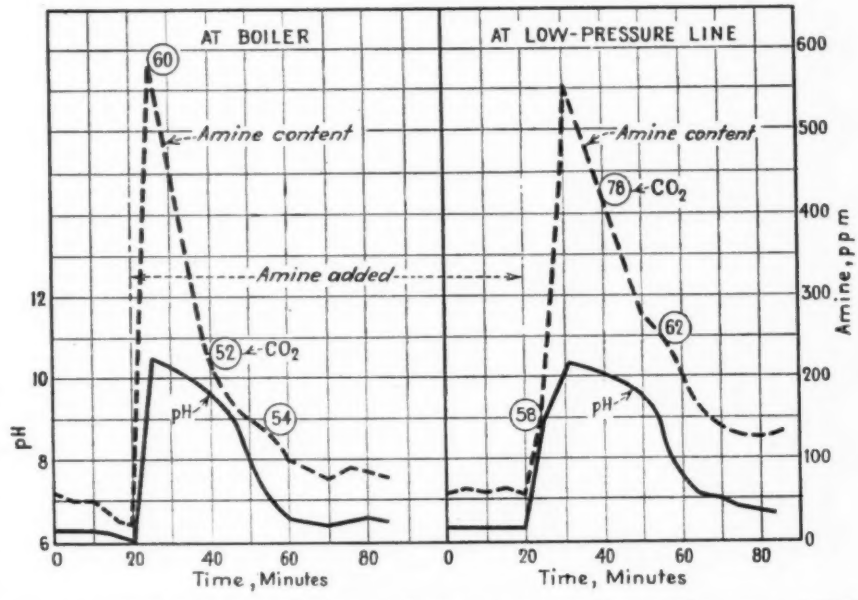


Fig. 6—Variations in the alkalinity and amine concentration of the steam caused by adding compound to the system when return condensate is adjusted to pH 9.1

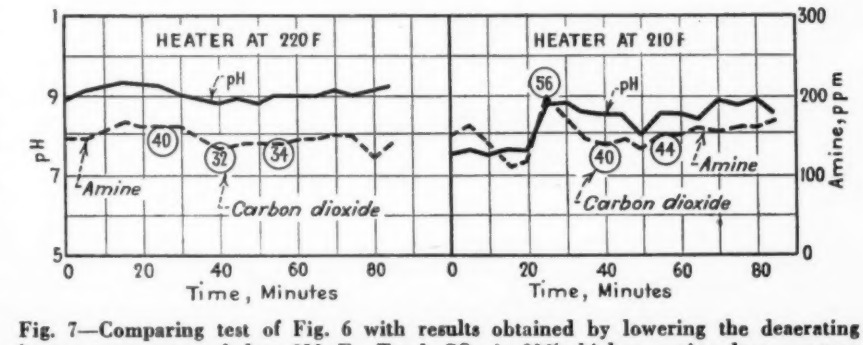


Fig. 7—Comparing test of Fig. 6 with results obtained by lowering the deaerating heater temperature below 210 F. Total CO_2 is 30% higher, amine loss constant

Proper Materials and Methods Make Power-Plant Cleaning Jobs Easy

Keeping equipment clean inside and out maintains efficiency and capacity, and helps to insure reliability. This article, second of two, discusses the wide variety of modern cleaning compounds, telling where and how to use them for maximum effectiveness

By DR R W MITCHELL
Technical Director,
Magnus Chemical Co, Garwood, N. Y.

EDITOR'S NOTE

Because an article of this kind must be specific to be useful to practical men, POWER has departed somewhat from its policy and included trade names that permit easy identification of the various cleaning compounds. Names in the table are merely representative and often other products may be available.

Instructions on solution strength and cleaning method apply to average cases and vary with amount of dirt and its nature. Reputable manufacturers give full instructions on use of their cleaning products and stand ready to advise on special problems. Dr. Mitchell's article naturally deals primarily with his company's products. For the portion of the tabular data referring to Oakite materials, POWER is indebted to R L Fiske and G A Lux, of Oakite Products Co.

► MODERN COMPOUNDS, fitted to the individual job, take much drudgery out of numerous power-plant cleaning operations, and save time and dollars as well. Here is a broad picture of basic materials and the kinds of dirt they remove most effectively, with a detailed discussion of some major cleaning problems. For handy reference, a comprehensive table on the facing page summarizes jobs, materials and methods.

In the past, strongly alkaline materials, including caustic soda itself, were used more or less indiscriminately. Modern alkaline cleaners, carefully compounded for specific characteristics, find wide use but are supplemented by many completely different materials, better suited for certain kinds of work. All these new cleaners meet five basic requirements, set down in a preceding article (POWER, Oct, 1944, pp 82-84). A good cleaner should (1) have no harmful effects on equipment or surroundings (2) be safe to handle and use (3) permit simple methods and involve minimum technical supervision (4) act as speedily as possible (5) hold over-all cleaning costs to a minimum.

Type of cleaner depends mainly on nature and composition of substances to be removed; characteristics of equipment to be cleaned usually determine application method and only indirectly affect choice of cleaning material. Substances to remove from power-plant equipment fall into two broad classifications: (1) various types of scales and sludges deposited from water and (2) oily or greasy deposits. Other materials are usually present—rust, carbon, metal particles and what may be called, for lack of a better term, common dirt. Both classes of deposits differ according to composition and effects of surrounding conditions, such as heat. The following paragraphs discuss these general classifications and show how specific cleaning compounds meet various specific requirements.

Perhaps the biggest power-plant cleaning job is maintenance of effective heat transfer by keeping tubes, boiler surfaces, condensers, water heaters and other heat exchangers free of scale and other water deposits. Hard-water scale is the chief offender, but even in areas where hardness is not excessive, deposits can and do accumulate from water impurities. Magnesium and calcium carbonate scales are commonest but other impurities form deposits just as hard to remove. The answer lies in routine cleaning with the proper compound to avoid heavy deposits that do not yield to treatment without dismantling.

Inhibited-Acid Cleaners

Alkaline cleaners can remove oils or greasy dirts incorporated in scale, but they exert no material effect on scale itself, which requires an acid cleaner. Obviously ordinary commercial acids, such as muriatic, involve danger of attack on metal surfaces. But development of inhibitors, which provide an effective dissolving action by an acid without harmful effect on metals, makes it possible to compound acid cleaners that do a safe and thorough job on water scale and deposits.

Inhibited-acid cleaners are available in both solid and liquid form. Liquid types prove stronger and quicker in action but require shipment in glass carboys. Solid cleaners act more slowly but can be shipped in barrels, are easily made up into solutions, and can be stored indefinitely without lumping or deterioration. Allowed sufficient time, they dissolve the heaviest deposits. However, for such deposits it is often desirable to restore original condition with fast-acting liquid and then use solid type regularly.

Acid cleaners are used in a water solution. Make it up in a supply tank at specified temperature, in sufficient volume to fill the system to be cleaned from supply tank and back. Tank should have at least three baffles to insure settling out of undissolved dirt carried over from the system. For suggested tanks, see POWER's Oct, 1944 article, pp 82-84.

A pump circulates the solution; required cleaning time varies with nature and extent of deposits. In regular cleaning one-hour circulation usually proves ample. Follow circulation of solution

(*Continued on page* 170)

TYPICAL COMPOUNDS AND METHODS FOR POWER-PLANT CLEANING JOBS

Equipment	*Nature of Dirt*	*Cleaner type*	*Trade name*	*Solution*	*Cleaning method*	*After treatment*
Oil heaters (oil side), burner parts, nozzles and other items exposed to oil and heat	Carbonized oil and sludge	Emulsifiable solvent	Magnus No. 75	Undiluted	Circulate at 160 F an hour or more	Flush with weak alkaline solution or oil
		Emulsifiable solvent, plus	Oakite No. 9 followed by	One part to 5–7 parts kerosene	Allow to soak, then drain	
		Heavy-duty alkaline cleaner	Oakite No. 19 or No. 22	8 oz to one gal water	Circulate at boiling temperature	Hot rinse
Oil coolers (oil side)	Emulsified oil, wax and sludge	Heavy-duty alkaline cleaner	Magnus Heavy-Duty Cleaner	4–8 oz to one gal water	Circulate at 160 F for 1 to 4 hours	Flush with hot water
		Heavy-duty alkaline cleaner	Oakite No. 19	8–10 oz to one gal water	Circulate at 160 F or more for 4 to 8 hours	Flush with hot water, blow out with air
Oil heaters, oil coolers, other heat exchangers, engine and compressor jackets (water side)	Scale (mostly carbonate), rust and corrosion products, occasionally mud, oil* or grease*	Inhibited acid (solid type)	Magnus D-Scale-R	8–16 oz to one gal water	Circulate at boiling temperature one or more hours. Vent gas	Flush with water and rinse with mild alkaline solution
		Inhibited acid (liquid type)	Oakite No. 32	One part to 3 parts water, or up to 50% by vol	Allow to soak, then drain, or use circulation method (cold)	Flush with water and neutralize with mild alkaline solution
Boilers, (steam, water side)	Scale, rust, perhaps oil	Inhibited acid (liquid type)	Magnus D-Rust-R	Minimum concentration of 8%	See text for details	Fill with water, drain, flush and neutralize
Boilers, newly installed	Grease, protective oil coating	Heavy-duty alkaline cleaner	Magnus H-D Clnr; Oakite No. 24	2–4 oz to one gal water	Circulate at 160 F or more for 1 to 4 hours	Flush
Meters, steam or water	Scale, rust, perhaps oil	Inhibited acid (liquid type)	Magnus D-Rust-R	Minimum concentration of 8%	Immerse parts at room temperature until gas evolution ceases; then soak 15 min more	Rinse in clean water, then weak alkaline solution, and finally water again
		Alkaline cleaner followed by	Oakite No. 24	4–8 oz to one gal water	Immerse in boiling solution	
		Inhibited acid (liquid type)	Oakite No. 32	One part to 2–5 parts water	Immerse for 10 min or more (cold)	Rinse, then neutralize in Oakite No. 24
Lube-oil filters, strainers	Emulsified oil, wax and sludge	Heavy-duty alkaline cleaner	Magnus H-D Clnr; Oakite No. 19	6–8 oz to one gal water	Immerse in boiling solution, 10–15 min	Drain, rinse in hot water, air dry
Fuel-oil filters, strainers	Carbonized oil and sludge	Emulsifiable solvent	Magnus No. 75	Undiluted	Immerse for 10 min	Drain, blow out with steam
		Emulsifiable solvent	Oakite No. 9	One part to 2–3 parts kerosene	Immerse for 15 min or more	Drain, blow out with steam
Air filters, viscous impingement type	Dirt and oil	Emulsifiable solvent	Magnusol	One part to 6–10 kerosene	Immerse for 10 min at room temperature	Drain, immerse in hot water, drain, dry, re-oil
		Heavy-duty alkaline cleaner	Oakite No. 24 or No. 20	2–4 oz to one gal water	Immerse at 130–180 F, for 15–45 min	Rinse, dry, re-oil
Air compressor cylinders	Hard carbon, carbonized oil deposits	Neutral soap with solvent	Magnus No. 55-P	One part to 9 parts water	Inject into cylinder through lubricator, with oil supply cut off. Run unit 3 hr	At end of 3-hr run, resume lube-oil feed
		Medium-duty alkaline cleaner	Oakite Penetrant	4–8 oz per gal water	Block off unit, circulate warm solution	Drain, rinse, relubbricate
Inter- and aftercoolers (air side) and air receivers	Carbonized oil, dirt, etc	Emulsifiable solvent	Magnus No. 75	Undiluted	Circulate at room temperature, 1–3 hours	Drain, flush with hot water, dry
		Alkaline cleaner	Oakite No. 24 or Penetrant	8 oz to one gal water	Block off unit; circulate or soak at 180 F	Drain, flush thoroughly
Diesel, gas-engine parts	Carbon, sludge, "lacquer," etc	Emulsifiable solvent	Magnus Cold Tank Cleaner	Undiluted	Soak at room temperature; 20–30 min to 4 hours	Spray rinse with water or safety solvent. Brush if necessary
		Emulsifiable solvent	Oakite No. 9	One part to 4–6 parts kerosene	Soak as required	Flush with light oil or solvent
Salvage cleaning: pipe, equipment, parts	Rust, scale, grease	Heavy-duty alkaline cleaner	Magnus H-D Clnr; Oakite 24; Test X	8 oz per gal water	Immerse in boiling solution; 15–30 min	Rinse with hot water, dry
	Badly rusted or scaled	Inhibited acid (liquid type)	Magnus D-Rust-R	50–50 solution	Immerse in hot solution; 3 min	Follow with cleaning treatment above
		Alkaline cleaner followed by	Oakite No. 24 or Text X followed by	8 oz to one gal water	Immerse in boiling solution, 15–30 min	
		Inhibited acid (liquid type)	Oakite No. 32	One part to 1–3 parts water	Immerse for 10 min or more (cold)	Rinse, then neutralize in Oakite No. 24
Cement floors	Oily and greasy deposits	Alkaline cleaner plus whitener	Magnus Cement Cleaner	5 oz per gal water	Sprinkle over wet surface, brush with water	Hose off or brush with clear water
		Alkaline cleaner	Oakite Penetrant or No. 20	1–2 oz per gal water	Apply hot, allow to soak, brush	Rinse or flush with clear water
Steel grating, steps, ladders	Oily and greasy deposits	Emulsifiable solvent	Magnusol	One part to 8 kerosene or solvent	Spray or brush on; allow to stand 15 min	Flush with water hose
Paint stripping		Heavy-duty alkaline cleaner	Magnus Heavy-Duty Cleaner	8 oz to one gal water	Flow on hot solution, or immerse	Flush off with steam jet or hose. Rinse
			Oakite Stripper or Oakite Stripper M3	4–16 oz to one gal water	Flow on hot solution, or immerse	Flush off with steam jet or hose. Rinse

* *If present, pretreat with alkaline cleaner*

Electronic Control Gives Dc Motors Wide Speed Range on Ac Power

B J Dalton, General Electric application engineer, explains the different electronic combinations for obtaining dc power from ac systems, defines their limitations, and tells how electronic control is used in some adjustable-speed and reversing motor-drive applications

► WHEN DC POWER is available, shunt motors with field or armature control, or both, readily provide a wide range of speed adjustment. But ac power, for comparable control, must be converted to dc and used with dc motors. Electronic methods, newest of several ways of accomplishing this, not only rectify from ac to dc but also adjust the motor's field and armature voltage to obtain maximum speed-range control. Let us consider the different electronic power supplies and their limitations.

Either vacuum or gas-filled electron tubes can be used as rectifiers to supply adjustable-voltage dc power from an ac supply. High losses inherent in vacuum tubes limit their use to supplying sensitive pilot-field currents or very small fractional horsepower motors.

An electronic rectifier without grid control can provide adjustable dc voltage only by changing its anode voltage. This change can be made automatically by a motor-driven tap changer or a saturable reactor in the ac line. Because this control equipment must be in the ac power line it is large and expensive. A grid-controlled electronic rectifier is used extensively because it provides adjustable dc voltage by simple low-cost control with a high degree of flexibility.

Dc Shunt Motor

Fig. 2 shows a dc shunt motor that has its armature current supplied by grid-controlled gas-filled tubes (thyratrons) *T* and its field current supplied by 2-element gas-filled tubes *G*. In the thyratrons the grid controls the average dc voltage to the motor's armature while the 2-element tubes provide practically constant voltage to the field windings. Each value of thyratron anode voltage requires a certain value of minus grid voltage, known as critical-grid voltage, to prevent the tube from conducting.

When the thyratron anode and grid voltages are in phase, the latter is above the critical value during the entire half cycle and the tube conducts during this period, Fig. 3. A grid voltage higher than the critical and 180 deg out of phase with the anode volts prevents the tube from firing and its output is zero. Fig. 4. A 90-deg phase shift between grid and anode volts permits the tube to conduct during one half of the half cycle, Fig. 5.

Therefore, by using a phase-shifting device, to obtain grid voltages 0 to 180 deg out of phase with the anode volts, tube output can be controlled between zero and maximum. If a shunt motor's armature is connected to the rectifier, as in Fig. 2, by grid-voltage phase control, its speed can be adjusted from near zero to full operating value. The grid-voltage phase-control device may be a small solenoid reactor, a saturable reactor or other appliance.

Because electron tubes conduct current in one direction only, a dc motor will not regenerate into a rectifier in the same sense that a motor regenerates into a generator or a dc line. By proper grid control and by reversing the motor armature connections, inversion can assist in stopping or reversing the motor.

The inverter circuit, Fig. 7, is the same as the rectifier circuit, Fig. 6, except that the reverse contactors *R* are closed. With this connection the mo-

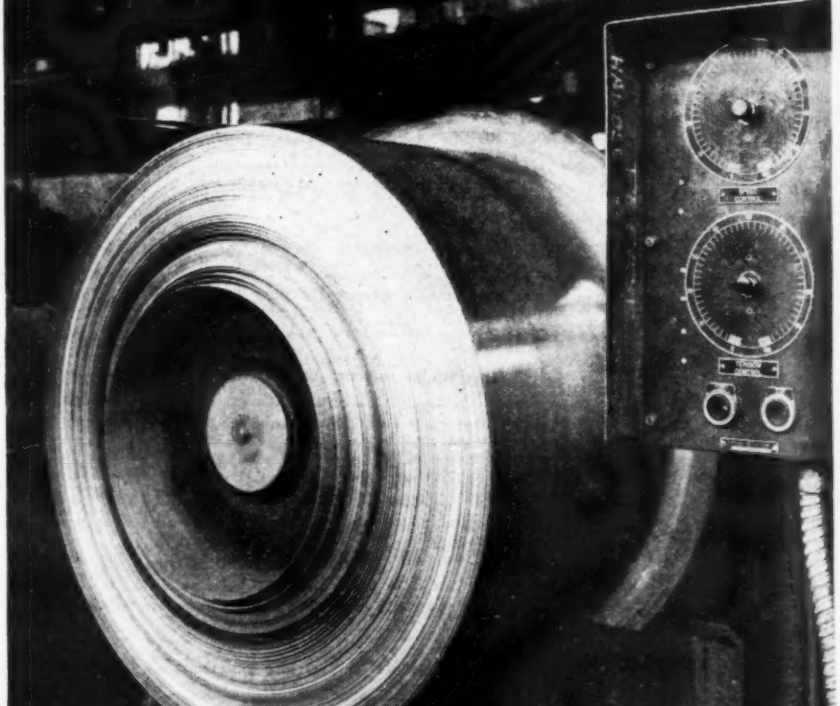


Fig. 1—On this steel-strip-coiler motor drive the electronic control increases the motor field strength to slow down the armature as the coil diameter increases

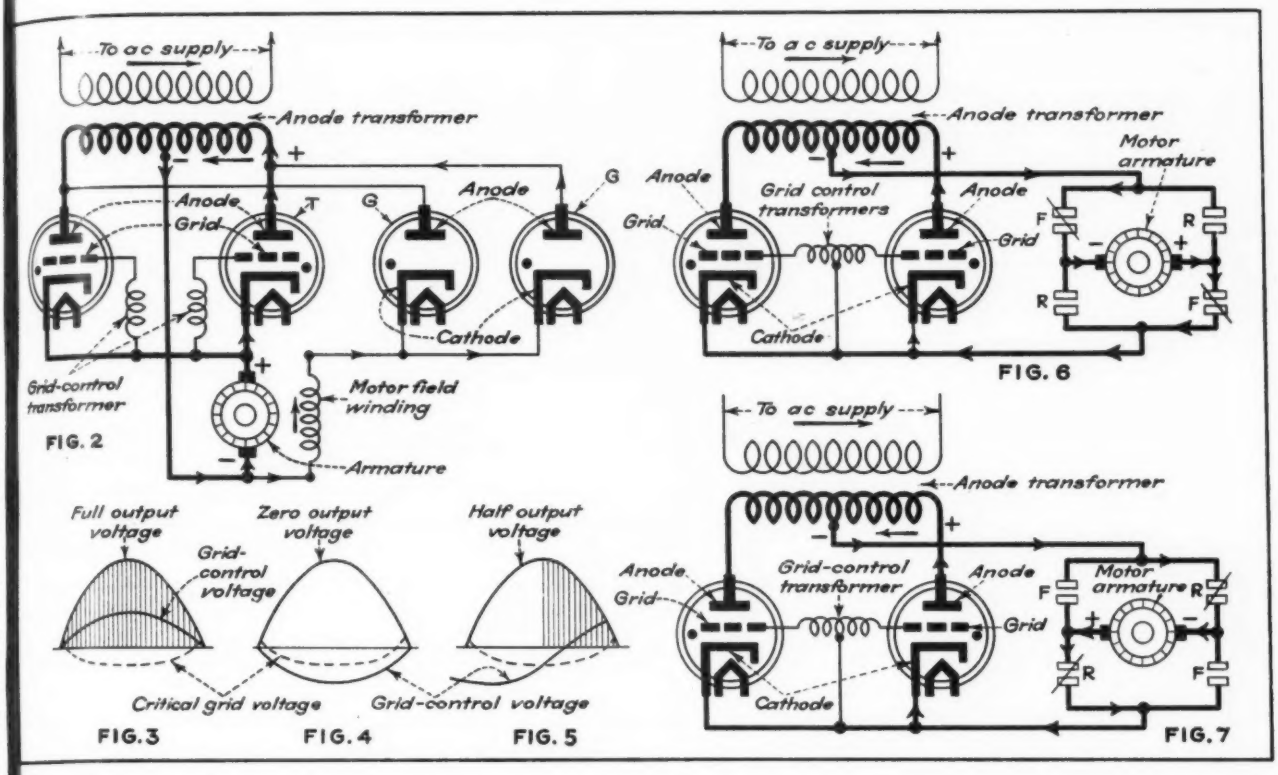


FIG. 2 FIG. 3 FIG. 4 FIG. 5 FIG. 6 FIG. 7

Fig. 2—Diagram of dc-motor drive with thyratron armature tubes and 2-element gas-filled tubes in the field circuit. Fig. 3 to 5—By shifting the grid-voltage phase with respect to anode-voltage, output of a thyratron tube can be controlled. Fig. 6—Armature rectifier with reversing contactor in forward direction. Arrows show the direction of electron flow. Fig. 7—Same as Fig. 6 but with armature reverse contacts closed for inverter operation when plugging the motor

tor's counter voltage and half the transformer voltage are additive, as indicated. If the tubes are made to fire early in each half cycle, a high plugging current results. However, when the tubes are fired late in each half cycle, even though the anode is still positive to a considerable degree with respect to the cathode, armature inductance sufficiently limits current rate of rise for successful operation. When transformer voltage reverses and becomes negative with respect to the center tap, positive anode potential is still available and conduction continues through one tube until voltage between anode and cathode reverses.

Inversion Current Flow

Current during inversion flows through the tubes in the same direction as in rectifier operation, but the active half of the anode transformer voltage is predominately negative. Therefore, the net power flow is back into the line. As motor speed decreases, the tubes can be fired earlier in the cycle to maintain the plugging current practically constant. To stop the motor, the tubes may be "phased off" when it reaches zero speed. To reverse it, gradually advance the grid firing to the same point in the cycle at which it was operating when reversal was initiated.

A single-phase full-wave rectifier is used in Fig. 6 and 7 because it is relatively simple. This rectifier circuit is generally limited to motors up to about 2 hp. Polyphase rectifiers on larger motors require grid control in each phase. Typical sizes and armature rectifier phases are: 3-hp 3-phase half-wave; 5-hp 4-phase half-wave; 10-hp 3-phase half-wave; 15-hp 4-phase half-wave; 20-hp double-wye 6-phase half-wave.

Twenty-five horsepower is near the feasible upper limit for a power supply using hot-cathode tubes. This is based on a 75-amp rectifier of six 12.5-amp tubes operated in a double-wye 6-phase half-wave combination. At 500 v, 37.5 kw can be obtained from this rectifier, which is sufficient to operate a 25-hp motor and provide a reasonable overload margin.

Higher voltages, more complex tube combinations, or larger thyratron tubes can increase the rectifier size. However, 500 or 600 v is about the maximum acceptable for industrial-plant motors. More complex tube combinations bring additional problems, which do not seem justified. Also, increasing the number of tubes presents a formidable obstacle to general acceptance of the equipment. While 100-amp thyratron tubes have been used commercially, mercury-pool-cathode ignition tubes, because of their lower cost and the tremendous overload capacity of their cathodes are inherently more suitable for large power applications.

Tests on adjustable-speed ignitron-controlled dc motors indicate that grid control may provide successful operation. Sealed-tube ignitron rectifiers start at about the top rating for hot-cathode rectifiers. Pumped-tank rectifiers continue in size to include 5000 kw at 600 v dc. Ignitron mercury-pool-cathode rectifiers then provide a way of extending all-electronic adjustable-speed drives to very large dc motors.

Electronic-Control Future

Only the future will tell whether the ignitron control's advantages will outweigh its disadvantages sufficiently to make large electronic motor drives attractive. Motor-generator sets have wide acceptance in the adjustable-speed field. Use of ignitron control, however, will undoubtedly increase in those applications where it has an advantage.

Industrial requirements are by their nature diversified. Therefore, while several standard power supplies may be satisfactory in most applications, no general grouping of control systems can solve all the problems of many specialized applications. Flexibilities of elec-

tronic control, however, make it ideally suited for these applications.

Fig. 8 shows the application of an electronic system of control to a dc motor driving the windup reel on a high-voltage cable-making machine. From a capstan the cable moves under a weighted roll and then onto the reel. A solenoid reactor, actuated by the weighted roll reduces armature voltage and speed as reel diameter increases.

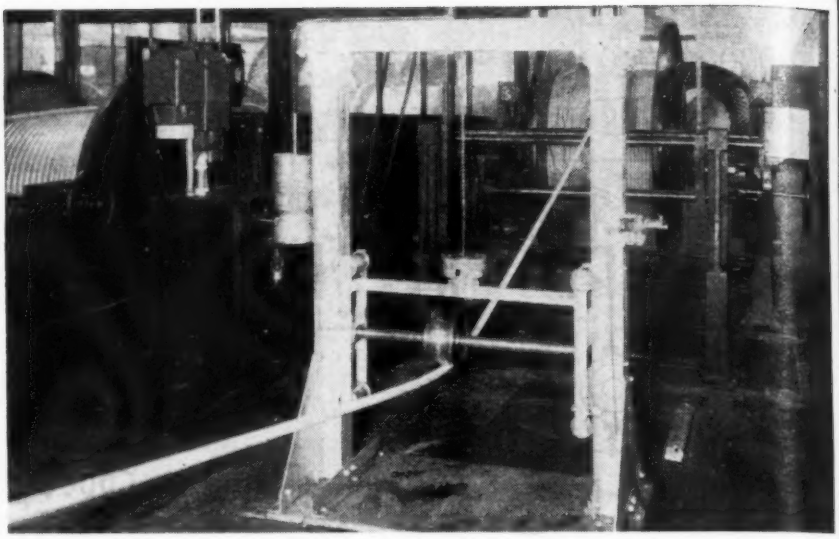


Fig. 8—In this system of electronic control on a cable reel, a solenoid reactor, actuated by a weighted roll reduces armature voltage and speed as reel builds up

Fatigue Testing

Fatigue testing of metals requires a constant maximum amplitude, velocity, or acceleration of vibration. If an electronically controlled motor drive produces the vibrations, a signal from contacts, a piezo-electric pickup, or a similar device can be fed to the control circuit to correct motor speed and thus maintain the vibrations constant.

Wire, paper, cloth or other materials are often wound on reels having a ratio between inside and outside diameters of 3 or 4 to 1. If constant material tension is required and the material speed is constant, the reel will require constant horsepower to drive it throughout its speed range.

Varying the field of an adjustable-speed dc motor according to the amount of material on the reel is one way of obtaining constant horsepower. If drive friction is relatively small, armature current can be used as an approximate measure of horsepower. Control for this application is designed so that a slight increase in normal armature current, due to too high a speed as the reel builds up, automatically strengthens the motor field to reduce the speed and thereby hold armature current essentially constant. The steel-strip coiler in Fig. 1 has this type of control on its driving motor.

Automatic arc welding requires the arc to be struck automatically and the welding-electrode feed rate held constant with respect to material-travel rate for a given amount of fill. Here, arc voltage is used to control electrode-motor speed. If voltage is too high, just right or too low, the motor runs forward, stops or reverses, respectively. In the forward direction, speed is proportional to arc voltage.

Control of dynamometers is an application with great diversification. Application of electronic motor-field control to dc machines in aircraft engine testing is but one example. Here, speed must be held accurate. If the dynamometer cranks the engine, speed should be the same as when the engine delivers power, but the time to correct the speed under this transfer condition should be short. During the performance of some tests it is necessary to hold constant the field current rather than the speed.

Photoelectric Control

Photoelectric loop control has recently been applied successfully to a 10-hp payoff-reel motor feeding a steel-strip shearing line at about 700 ft per min, Fig. 9. In this system, amount of light striking a 20-in.-high phototube bank controls the motor-field strength, thereby determining motor and strip speed. Steel-loop position is held approximately constant, even during acceleration on an adjustable-voltage bus by the loop modulating a light beam from the light bank.

A few of the many possibilities for electronic methods to aid in the control of industrial processes are (1) speed adjustment of textile-range drives according to moisture content of cloth (2) oven conveyors with temperature (3) pumps with pressure.

Because functions, speeds of response, or accuracies otherwise impossible are often made practical by electronic control, we can be optimistic about its future. Remember, however, that real progress will result only from recognition that electronics is not a panacea but a useful tool to apply as carefully as, or perhaps even more carefully than, any other industrial tool if expected results are to be attained.

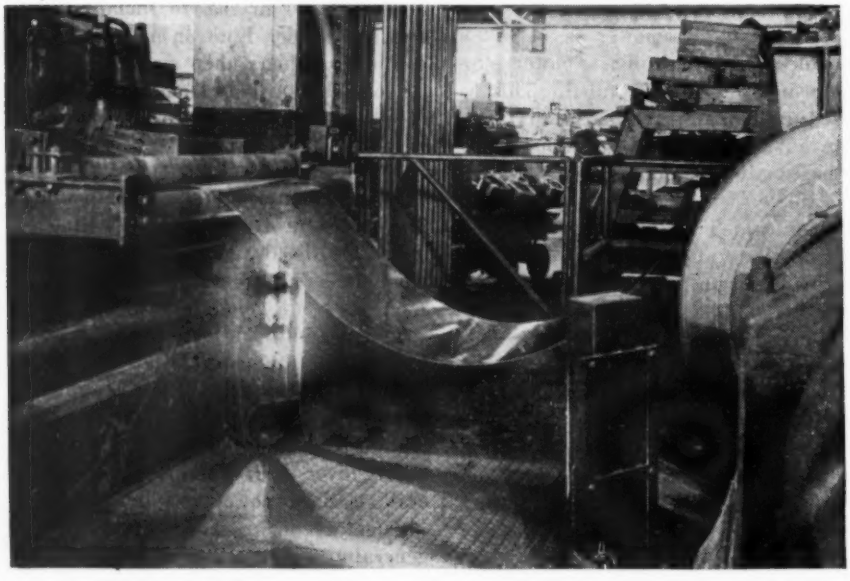


Fig. 9—Photoelectric-tube control applied to a 10-hp payoff-reel motor, feeding a steel-strip shearing line at about 700 ft per min, holds correct loop in strip

Hydraulic Drives

By F A ANNETT, Associate Editor

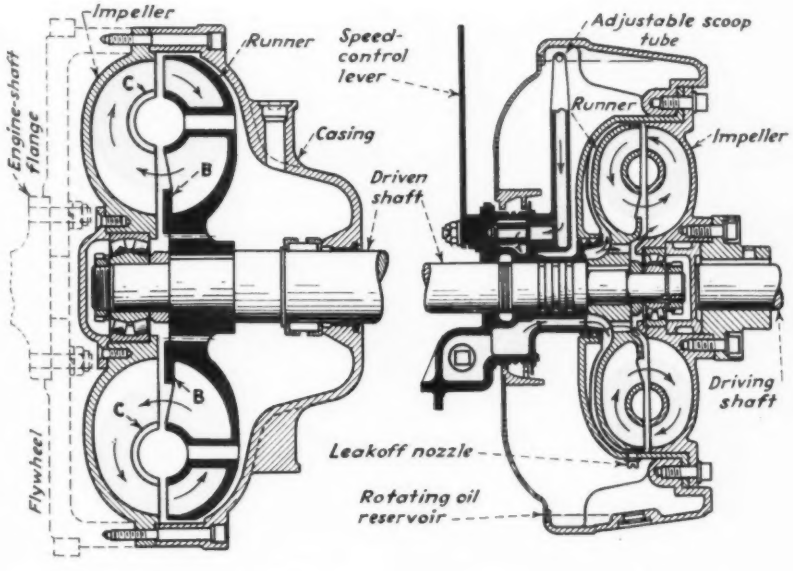
Hydraulic units meet such a wide range of drive requirements in power and industrial plants that every engineer should know what they are and what they can do. This special section, Power's 52nd, concisely describes construction, operation and characteristics of hydraulic couplings, torque converters and variable-speed transmissions

Couplings

Hydraulic couplings have a wide range of applications for two general classes of service: constant- and variable-speed drives. They are built for almost any power from ½ hp up, to connect internal-combustion engines and electric motors to their loads in power and industrial plants, in transportation, and in such fields as marine, construction, and oil-well drilling. Hydraulic torque converters, which will be explained later, are built on a similar principle.

Hydraulic couplings are also known as fluid couplings, fluid drives, hydraulic clutches and hydraulic drives. Constant-speed (traction) and variable-speed designs, Fig. 1 and 2, are essentially alike in construction except for the latter's speed-control device. Each has a primary and a secondary element. The primary element may be considered a centrifugal-pump impeller and the secondary, or output element, a waterwheel.

In Fig. 1 the impeller is shown cross hatched and coupled to an internal-combustion-engine crankshaft. The part illustrated in solid lines is the runner or waterwheel, which is keyed to the driven shaft. The coupling is filled with a light mineral oil of steam-turbine quality. When the engine drives the impeller, it discharges oil through the runner buckets back to the impeller, which causes the runner to rotate with the impeller.



1 Section through traction-type hydraulic coupling shows flow of fluid in the unit's working circuit

2 Section through a scoop-controlled hydraulic coupling built for variable-speed requirements

Impeller and Runner

Fig. 3 shows the inside of an impeller and runner. When the two face each other in a coupling, center rings *R* form the ring core *C*, Fig. 1, about which the fluid circulates. When the impeller rotates liquid is discharged by centrifugal force from passages *A* in the impeller into passages *B* of the runner. The fluid then flows back of the ring core *R* and afterwards returns to the impeller.

Fig. 5 is a cross-section of a twin hydraulic coupling of the constant-speed (traction) design. This coupling

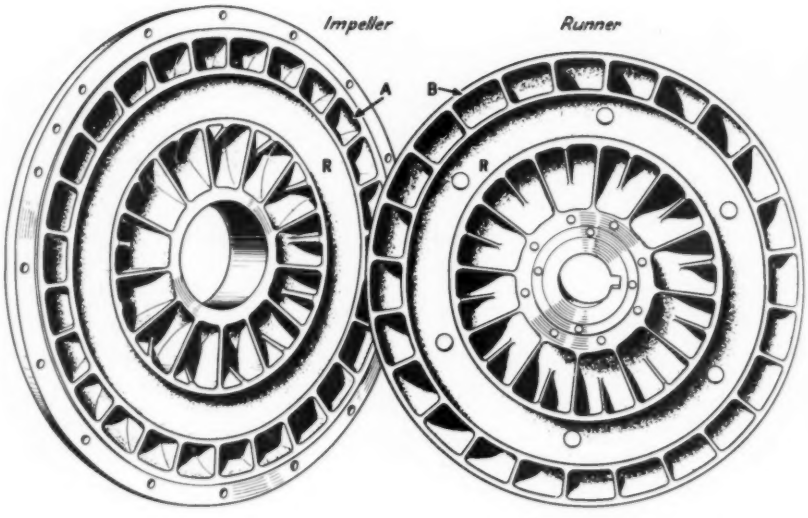
has two runners connected back to back on a hub keyed to the output shaft. A runner faces each impeller. These form part of the coupling casing, which is supported on two ball bearings on the output shaft. Arrows indicate oil circulation between impellers and runners and show two separate working circuits. The circuits are kept comparatively narrow to reduce overall length of the coupling. The circuits are further pinched in at the outside diameter to reduce the weight, the quantity of oil required, and the flywheel effect of the unit. The area variations around the circuits are so proportioned as to secure minimum drag torque with maximum torque capacity.

Oil discharged from the impeller to the runner produces an axial thrust that tends to separate the two. In the twin coupling, axial thrust of one working circuit opposes that of the other and they balance out to put the runner in axial hydraulic balance. Blades in impellers and runners are straight so that the coupling operates equally well in either direction of rotation, as does the one in Fig. 1. Since the hydraulic circuit is substantially the same in both impellers and runners, either may serve as the input or output member.

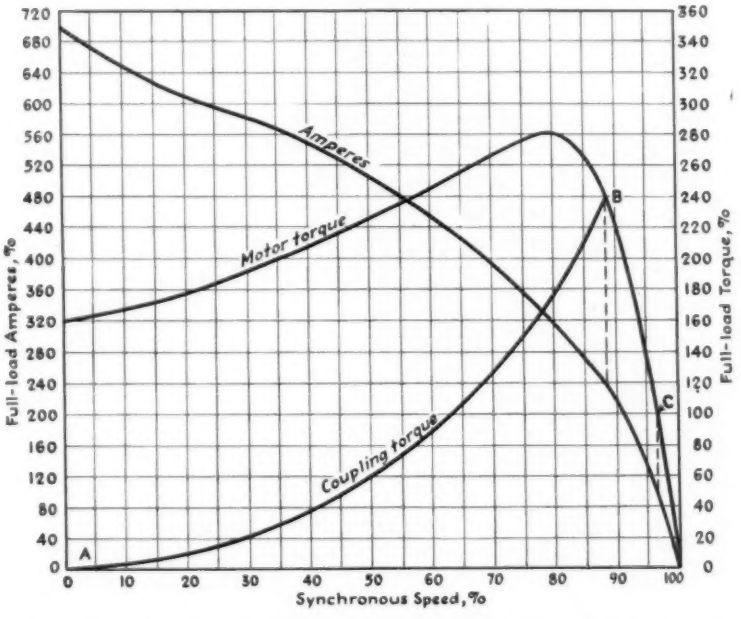
Torque Transmission

There is no mechanical connection between the two elements of a fluid coupling, torque being transmitted from impeller to runner by the fluid. Speed ratio between the two depends on the amount of oil in the coupling and kind of load. With the coupling working circuit full of oil, the output shaft at full load operates at about 3% lower speed than the input shaft. This is known as the full-load slip of the coupling. Reducing the amount of oil in the coupling reduces its output speed. Output-shaft torque equals that of the input shaft under all conditions.

In a constant-speed coupling, Fig. 1 or 5, at standstill the oil is in the casing bottom so that the power unit starts under practically no load. As the power-unit speed increases, oil automatically returns to the working circuit to accelerate the load smoothly. In Fig. 1, baffle *B*, a metal ring attached to the inner periphery of the runner circuit, reduces the drag torque at starting and limits the stalling torque. The reason is that at slow speed and high slip the oil does not all flow along the outer periphery of the working circuit, so that the baffle interferes with its flow and reduces the torque. At full speed, working-circuit fluid takes the position shown, clears the baffle and transmits maximum torque from impeller to runner.



3 Construction of impeller, *left*, and runner, *right*, for a traction hydraulic coupling. These operate facing each other, as in Fig. 1, 2



4 Performance curves of general-purpose squirrel-cage motor connected by hydraulic coupling to load with hard-starting characteristics

A fluid coupling between a power unit and its load serves as an automatic clutch. As such it makes possible the use of simple general-purpose squirrel-cage motors for applications that would otherwise require a higher-cost lower-efficiency motor and sometimes a complicated control. The coupling relieves the motor of shock loads, makes shear pins unnecessary and prevents the motor being subjected to stalling loads.

Fig. 4 shows how a fluid coupling performs as an automatic clutch when connected between a simple general-purpose squirrel-cage motor and its load. The motor speed-torque curve is that of an 1800-rpm motor with a starting torque of 160%, and a peak torque reaching 280% at about 80% synchronous speed. When the motor switch is closed it develops a torque of 160% on an inrush current of 700% full-load amperes, but the coupling torque is zero. As a result the motor accelerates quickly and the starting current decreases.

As the motor accelerates, coupling torque increases practically as the square of the impeller speed until at about 88% motor synchronous speed,

the coupling and motor torques are equal at 240% full-load value, point *B*. At this point the motor develops its torque with 240% full-load current. Beyond point *B* full motor torque is available to complete accelerating the load, which comes to about 97% synchronous speed and full load, point *C*. The curve from *A* to *B* and down to *C* is the torque that the coupling transmits from the motor to the load.

Regardless of the connected-load characteristics, the traction-coupling-equipped motor starts without load, because at zero speed the coupling torque transmitting capacity is zero, point *A*. The motor therefore accelerates quickly, the coupling delivering increasing torque to the load along torque curve *AB* until the load starts to move. Coupling slip then decreases rapidly until motor full-load torque is delivered to the load at about 3% slip (97% efficiency).

The coupling handles overloads smoothly and automatically. If an overload occurs coupling slip increases and the motor slows down to develop increased torque. Coupling torque increases following back along curve *CB*, with motor current increasing along starting current curve. When the overload ceases the motor and coupling return to normal operation.

If the load jams, the motor slows down to about 88% synchronous speed and its torque increases along curve *CB*. At *B* the motor torque exceeds that of the coupling and the load stalls, but the motor continues to operate and develop about 240% full-load torque on about 240% full-load current. Under these conditions if the motor is properly protected, its protective device quickly opens and disconnects it from the line.

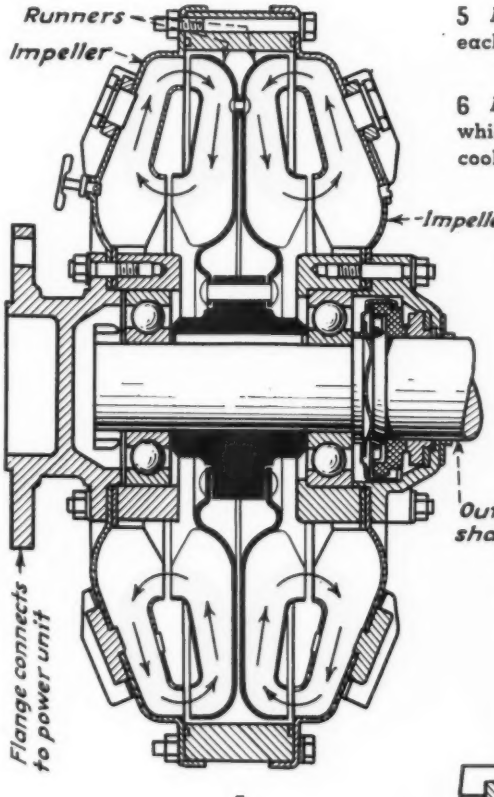
Diesel-Engine Drives

A fluid coupling between a diesel engine and its load performs in a manner similar to a coupling on a general-purpose squirrel-cage induction motor. It permits the engine to start without load, and gradually picks it up as the engine comes up to speed. The engine cannot stall because an overload merely slows it down and increases the slip in the coupling. The output shaft may be stalled under full engine torque, while the engine continues to run at reduced speed.

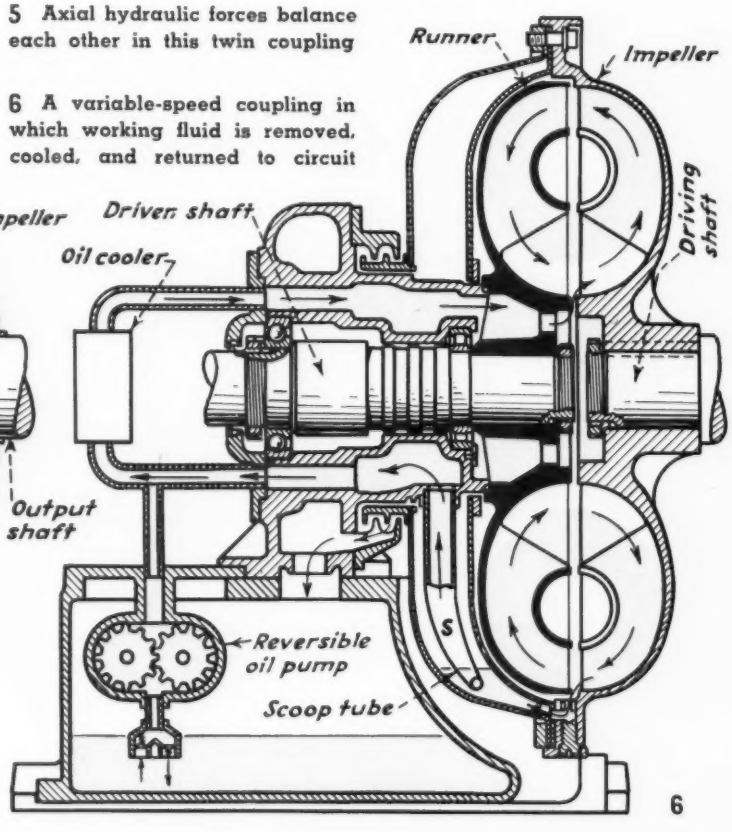
The coupling also serves as a flexible connection between engine and load to prevent transmitting shocks and torsional vibration from engine to load or from load to engine. Two or more engines connected to the same load by hydraulic couplings, as in marine applications, automatically divide the load between them. If one engine tends to run a little faster and take more load than another, slip increases in its coupling to maintain its load practically constant.

Practically the same coupling design, Fig. 1, is used for variable-speed applications except that a means is included for filling and emptying the coupling. One method uses a scoop tube, Fig. 2. The part shown in heavy, solid lines is a stationary manifold, which supports the scoop tube within the casing. This tube can be swung through an arc of about 70 deg to control the filling of the coupling and its output speed.

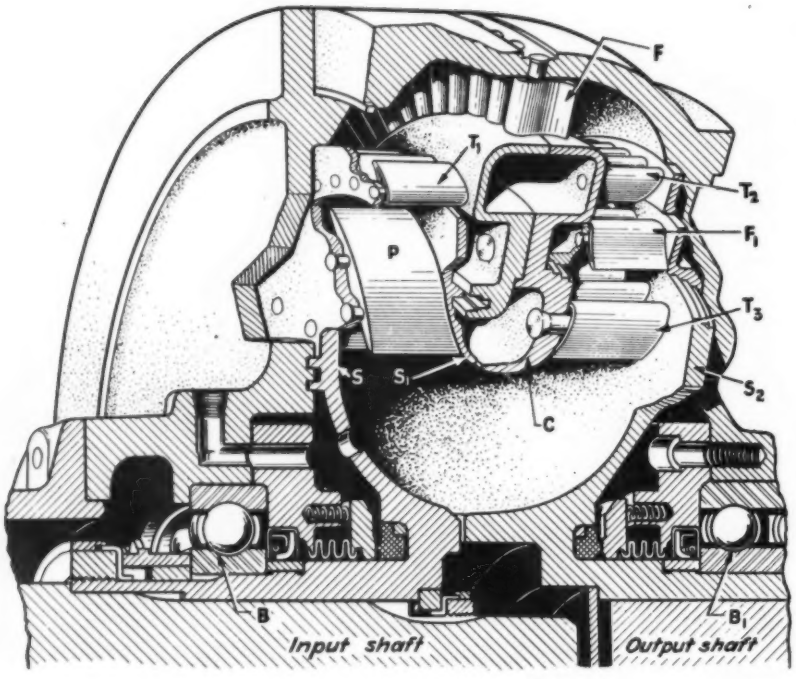
The outer casing connects to the impeller, revolves with it and acts as a reservoir for the oil not required in the coupling to transmit power at a given speed setting. With the coupling empty it transmits no power, then by swinging the scoop into the annular ring of oil the coupling's working cir-



5 Axial hydraulic forces balance each other in this twin coupling



6 A variable-speed coupling in which working fluid is removed, cooled, and returned to circuit



7 Construction of a typical hydraulic torque converter: P is impeller, T_1, T_2, and T_3 are runner vanes and F and F_1 are the fixed vanes

cuit is filled to give the desired output speed. By control of the amount of oil in the working circuit any output speed may be had between 20 and 97% of input speed.

Leakoff nozzles around the inner-casing rim allow a constant flow of oil from it to the rotating reservoir, from which it is picked up by the scoop, circulated through a cooler and returned to the working circuit. Thus, while the coupling is in service there is a constant circulation of oil between the working circuit to the casing and back. When the working circuit of the coupling, Fig. 2, is full of oil it performs like the one in Fig. 1.

The working circuit of this type of coupling can be empty and its scoops fully retracted when the power unit is started, so that it accelerates to full speed without load. Then, the scoop is advanced to fill the coupling and accelerate the load to the desired speed so that the coupling gives control of acceleration and output speed. Thus it is suitable for a wide range of applications, such as driving fans, pumps, compressors, centrifugals, ball mills, crushers and other equipment, for speed control and for difficult starting loads, or both.

For the larger-sized variable-speed couplings a design, Fig. 6, is used. In this, a stationary scoop S continually removes part of the oil from the coupling, passes it through a cooler and returns it to the working circuit, as indicated by the arrows. To control output-shaft speed, a small reversible motor-driven rotary pump supplies oil from the coupling's reservoir to or removes it from the working circuit. Oil removed is stored in the reservoir.

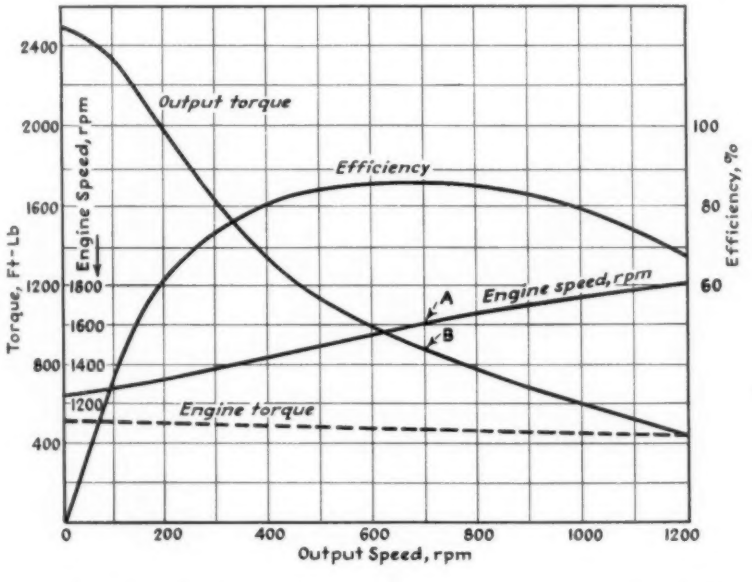
The pump driven by a polyphase motor is controlled by a reversing switch, actuated by a forward and reverse pushbutton or pistol switch. Mercury switches can actuate the magnetic switch under automatic control.

Torque Converters

A hydraulic torque converter may be considered a member of the hydraulic coupling, or clutch, family. Output torque of hydraulic couplings always equals input torque. If load increases, prime-mover torque increases to that required by the load and the coupling slip increases to where its torque equals that of the prime mover. In a hydraulic torque converter the output torque increases above input torque as the output-shaft speed decreases.

Fig. 7 shows a section of a hydraulic torque converter. This equipment is essentially a single-stage centrifugal pump discharging through a 3-stage turbine. P is one of a ring of the pump's impeller vanes supported between shrouds S and S_1. These shrouds support the impeller on the input shaft. T_1, T_2 and T_3 are three rows of blades fixed on the turbine rotor, which comprises the central part C of the converter and shroud S_2. The latter supports the turbine rotor on the output shaft.

Between the rows of turbine-rotor



8 Internal-combustion-engine and torque-converter characteristics. At 1800 rpm, engine shows same torque that converter has at 1200 rpm

blades are two rows of fixed guide blades F and F_1, supported in the converter's casing. The stationary casing supports the input and output shafts on ball bearings B and B_1.

Driven directly by the engine the impeller's discharge delivers its full impact to the first row of turbine blades, T_1. After leaving them the fluid is turned by the housing through guide blades F, which direct its flow through the turbine's second-stage blades, T_2. As the fluid flows toward the converter's center it passes through a second row of guide vanes, F_1, which change its direction for correct impact with the turbine third-stage blades T_3. The fluid then completes its circuit by entering the impeller.

A small auxiliary fluid pump driven by the input shaft maintains a fixed pressure on the fluid in the converter's housing. This pressure prevents cavitation at the impeller and turbine blades.

Torque multiplication in the converter results from the guide or reaction blades. These blades are stationary in the casing and cannot move when the fluid strikes them so it is redirected to the next turbine stage to increase the torque in much the same way that steam flowing through the blades of a reaction turbine increases the torque in each succeeding stage.

Characteristic Curves

Fig. 8 shows the characteristic curves of a hydraulic torque converter connected to an internal-combustion engine. At an engine speed of 1800 rpm, converter's output torque (at 1200-rpm output-shaft speed) equals engine torque, 500 ft-lb. Assuming the engine to operate on fixed throttle, if load increases it slows down, but its torque remains practically constant at 500 ft-lb.

When the load slows down the engine to 1600 rpm, point A, the converter's output shaft has slowed to 700 rpm, but its torque increases to 900 ft-lb, point B, or about double that at 1200 rpm. At this point the converter develops its maximum efficiency, about 85%. Its efficiency curve is fairly flat, being above 80% between 400 and 1000 rpm output speed.

Increasing the load, to where the torque converter stalls, slows the engine down to 1250 rpm, but torque developed by the output shaft increases to 2500 ft-lb, five times that at 1200 rpm output speed. Thus, the torque converter prevents the engine stalling and at the same time delivers a torque several times that produced by the engine shaft to drive the load.

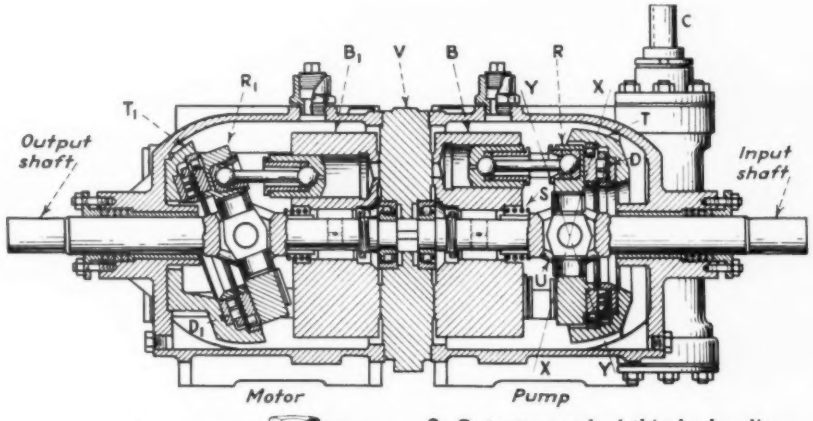
Hydraulic torque converters are used on internal-combustion-engine-driven oil-field hoisting-and-drilling rigs, locomotives, locomotive cranes, logging and other equipment.

Variable-Speed Transmissions

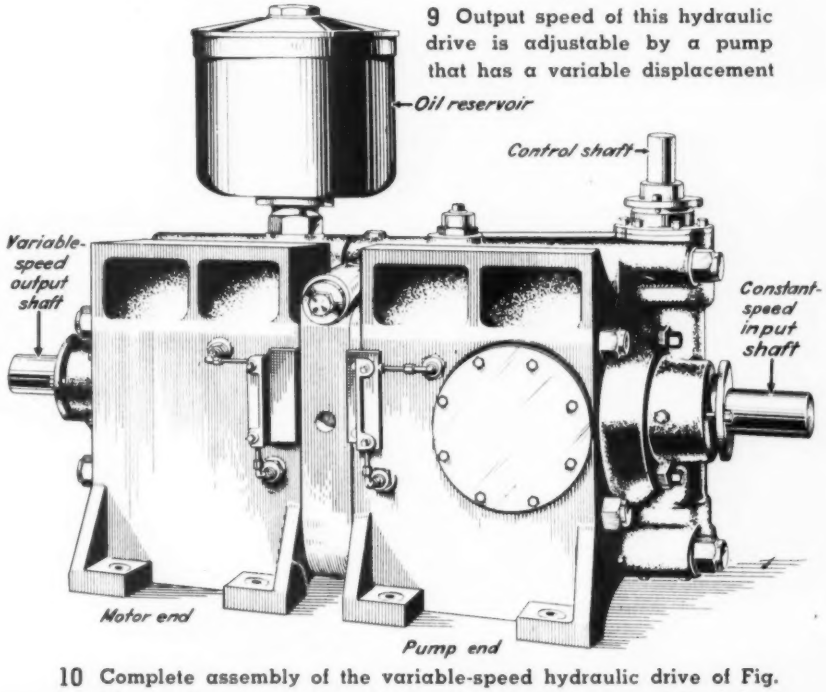
Hydraulic variable-speed units of the positive-drive type find extensive use in power applications requiring close control over a wide range of speed and load. Each unit consists essentially of a constant-speed motor-driven variable-displacement pump that supplies oil to a constant- or a variable-displacement hydraulic motor. By adjusting the pump's stroke, amount of oil delivered to the motor varies and, consequently, its speed. These drives are built in two general designs, parallel and radial piston, and in sizes from fractional to several hundred horsepower.

Fig. 9 shows a cross-section through a parallel-piston design with a variable-displacement pump and a constant-displacement motor combined in a single variable-speed unit. Where desired, pump and motor may be operated as separate units connected by a discharge and a return pipe. Pump and motor ends are practically the same except that the position of the pump's piston-rod socket plate can be adjusted to vary its stroke.

In Fig. 9, the pump consists of a tilting box T in which socket ring R revolves. T is held stationary by a connection to the control worm C. R connects to the input shaft by a universal joint U and rests against a



9 Output speed of this hydraulic drive is adjustable by a pump that has a variable displacement



10 Complete assembly of the variable-speed hydraulic drive of Fig. 9, with an oil reservoir to maintain the pressure system full of fluid

roller thrust bearing *D* in the tilting plate, on which it revolves. The socket ring has seven or nine bronze sockets for an equal number of piston connecting rods with spherical ends. The pistons and cylinders are ground to a good fit, which keeps leakage small without use of piston rings.

Spiral spring *S* between cylinder barrel *B* and a collar on the input shaft holds the barrel against valve plate *V*, when they are not under pump pressure. When the pump is in operation the barrel is held against the valve by pressure resulting from the difference in the valve-plate and cylinder-port areas. Two semicircular ports that pass through plate *V* connect the pump with the motor. Each of the ports extends through an arc of about 170 deg on each side of the plate's vertical axis, and therefore cannot be seen in Fig. 9.

Barrel *B* has as many equally spaced semicircular ports as it has cylinders. As the barrel revolves with the input shaft its ports pass in succession over the valve-plate ports. One of the latter acts as an intake and the other as a discharge port for the pump cylinders. Two relief valves in valve plate *V* have ball check valves through which oil flows from the reservoir, Fig. 10, to keep the pressure system full.

Socket ring R_1 in the motor is similar to that in the pump. Angle box T_1 performs a similar function to that of tilting box *T*, but is not adjustable and carries socket ring R_1 on roller bearings at a 20-deg angle from the vertical. Pump and motor rotating elements are supported by a bronze sleeve bearing in the casing and by a roller bearing in the valve plate. A universal joint *U* connecting socket ring *R* to the shaft permits free movement of the ring as the shaft rotates. The input shaft drives the cylinder barrel through two barrel keys that fit in ways machined in the shaft.

Tilting-Box Socket Ring

Tilting box *T* and socket ring *R*, Fig. 9, are in the vertical or neutral position. If the input shaft is turned, socket ring *R* and cylinder barrel *B* turn with it, but the pump and motor pistons have no motion in their cylinders. Turning control *C* until socket ring *R* takes a position *XX*, pulls the top pistons farther out of their cylinders and pushes the bottom ones in, as indicated by position of motor's socket ring.

With the socket plate tilted to position *XX*, when the socket ring and cylinder barrel are turned one-half revolution, pistons that were on top will be at the bottom and those at the bottom will be at the top. In this rotational-position change, pistons that were at the top are pushed in as they move to a bottom position. Those at the bottom, which had been pushed in, were pulled out as they came up to the top position. That is, by rotating the socket plate and cylinder barrel, when the former is tilted, the pistons are moved in and out of their cylinders.

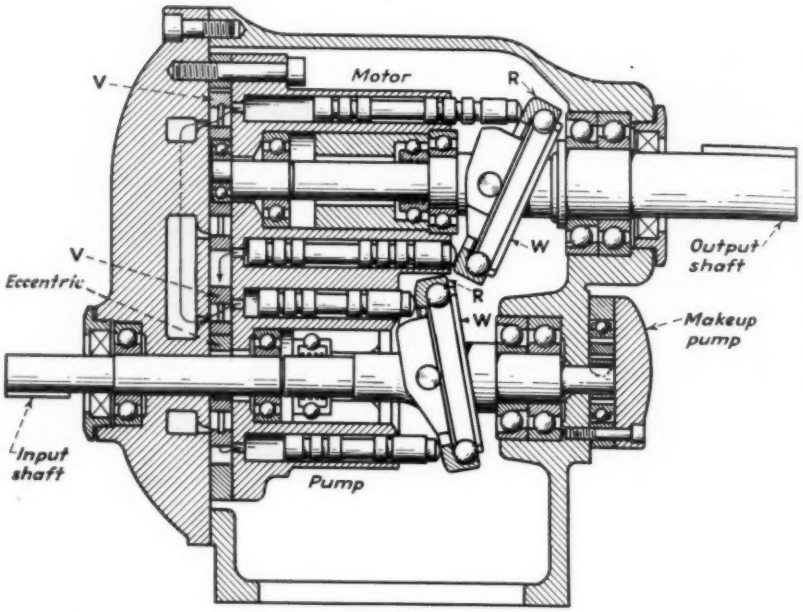
Assume that you are looking at the input end of the unit when the shaft turns clockwise. As the cylinder barrel and socket ring turn, pistons and cylinders move up on the left and down on the right. This causes the left-hand pistons to pull out of their cylinders and draw oil into them from the valve plate. On the right, the pistons move into their cylinders and force oil out through the valve-plate port and into the cylinders of the motor to drive it.

When pistons are at top or bottom dead center they are over the dividing walls between the two valve-plate ports. While the pistons pass over these walls they change from suction to discharge. Amount of pump-piston motion and, consequently, quantity of oil pumped to the motor, and its output-shaft speed, depend on the socket-plate angle.

When the pump socket plate has the same angle, 20 deg, as the motor, output speed is about the same as input speed. As the pump's socket plate is moved toward the vertical or neutral position, motor's speed decreases until it is zero with socket plate vertical.

On moving the socket plate beyond the vertical toward position *YY*, Fig. 9, top pistons are pushed farther into their cylinders and bottom ones are pulled farther out. This reverses the output speed of the motor and its speed continues to increase until the pump's socket plate has the same angle as the motor's, when output and input speed will be equal. The transmission therefore provides output-speed changes in infinite steps from zero to input value in either direction of rotation.

Load changes, oil temperature and viscosity affect the accuracy of the slow-speed control. When accurate control at slow speed is required over a wide load range, limit minimum output speed to about 1% of maximum required. That is, if the maximum output speed is to be 500 rpm, limit minimum speed to 5 rpm.



11 Displacement of both pump and motor of this variable-speed drive and torque converter is varied by changing angles of their wobblers

Pump and Motor Assembly

Fig. 11 is the cross-section through a hydraulic variable-speed transmission and torque converter comprising a variable-displacement multi-piston pump, which delivers oil to a variable-displacement fluid motor of the same design. In this transmission the piston barrels do not rotate and the pistons are not connected to the wobble plates. The piston's free ends are spherical and ride against a ring *R*

that rests against a ball thrust bearing on wobble plate *W*.

A small makeup pump, driven by the input shaft, supplies oil from a reservoir for charging the pump's pistons at sufficient pressure to hold them on their return stroke against the wobble-plate face. It also supplies makeup oil lost by piston leakage or slippage in the closed circuit between pump and motor. Oil not required to replace this leakage is bypassed through makeup pump's relief valve and used to lubricate the wobblers and bearings of pump and motor.

The motor, from an eccentric stud on its shaft end, and the pump, from an eccentric on its shaft, actuate circular valves *V* to control oil flow from pump to motor. These valves do not rotate but are given a gyrating motion as the shafts turn, to open and close ports leading to pistons and cylinder in pump and motor. These valves do not require timing adjustment as the eccentric drives are ground to give correct timing.

The transmission of Fig. 11 operates on the same principle as that of Fig. 9. In Fig. 11 the pump's bottom piston has completed its suction stroke and the top one its discharge stroke. The path of this discharge is indicated by the arrow to the top piston of the motor, which has completed its driving stroke. When the pump's wobble plate makes one-half revolution its top piston will have completed its suction stroke and the bottom piston its discharge stroke. During this period if the pump and motor wobblers have the same angle, the motor shaft has made a half revolution. In doing this, the motor's top piston will have moved to full discharge and its bottom to full driving position.

If the pump's wobbler is set at an angle to give its pistons one half the stroke length of the motor, the motor shaft will rotate at one half pump-shaft speed, but output torque will be double input torque. On the other hand, if the pump's wobbler is set for full stroke and the motor's for one-half stroke, motor speed will be double pump speed and the motor will develop one-half the torque of the pump.

Speed Adjustment

From the foregoing it is evident that output-shaft speed can be adjusted above or below input speed depending on the wobbler's angle. This angle is governed by a control mechanism not shown. When the unit is stopped, pump wobbler is at right angles to its shaft and the pump pistons do not reciprocate. Motor wobbler is set for maximum piston stroke in stop position. After starting the driving motor of the pump under no load, its wobbler is adjusted to start the fluid motor which develops maximum torque. As output speed increases, pump wobbler angle increases and fluid-motor wobbler angle decreases.

A hydraulic-control mechanism regulates wobbler angles. Pulling out the control stem 0.25 in. from neutral produces right-hand rotation, and pushing 0.25 in. beyond neutral gives left-hand rotation. These units develop constant output horsepower over a speed range of 500 to 2400 rpm. Below 500 rpm, output torque increases as speed decreases; however, horsepower also decreases, but at a slower rate.

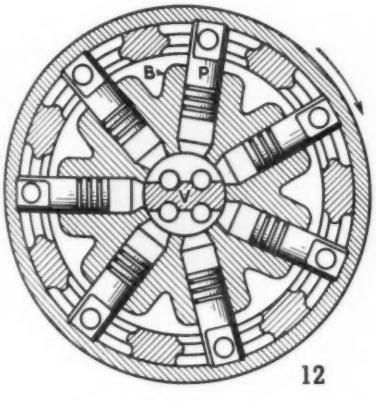
Usually radial-piston hydraulic variable-speed transmissions use a separate pump and fluid motor. First consider a variable-displacement pump. It has a number of radial cylinders and pistons that rotate about a fixed control cylindrical valve or pintle, Fig. 12 to 14. Piston assembly position is adjustable so that its center of rotation can be changed relative to that of the cylinder body to control volume of fluid pumped.

When cylinder and piston assemblies rotate about the same center there is no pumping action. Increasing the distance between their centers increases the volume of fluid pumped. The constant-displacement motor is the same as the variable-displacement pump, but its piston assembly is fixed off center a maximum distance relative to the cylinder body.

Fig. 12 to 14 show how a variable-displacement pump operates. In Fig. 12, pistons *P* and cylinder body *B* are concentric with cylindrical valve *V*. When the cylinder body and pistons are in this position, rotating them about the valve does not cause any motion of the pistons in the cylinders and consequently no pumping action. Moving the floating ring, which carries the pistons, off center with the cylinder body and the valve, Fig. 13, causes the pump to discharge.

Assume clockwise rotation as indicated by the arrow. Then pistons above the horizontal diameter move into the cylinders and discharge through the two top ports in the valve. Below the horizontal diameter the pistons are pulled out of their cylinders and fluid flows into them. In other words, pistons in the pump's bottom half are on their suction stroke while those in the top half are discharging.

Moving the floating ring with its piston assembly so that its center of rotation is to the right of central valve *V*, Fig. 14, reverses pump operation. Now, for the same rotation direction, pistons above the horizontal diameter are pulled out of their cylinders and



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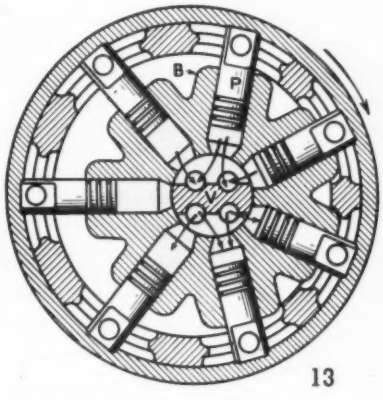

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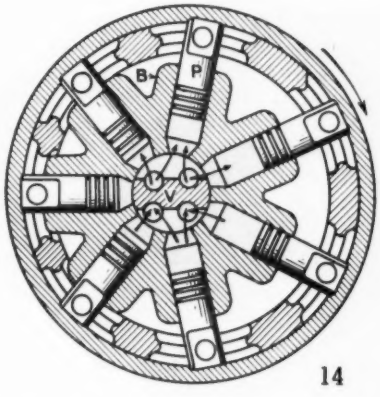
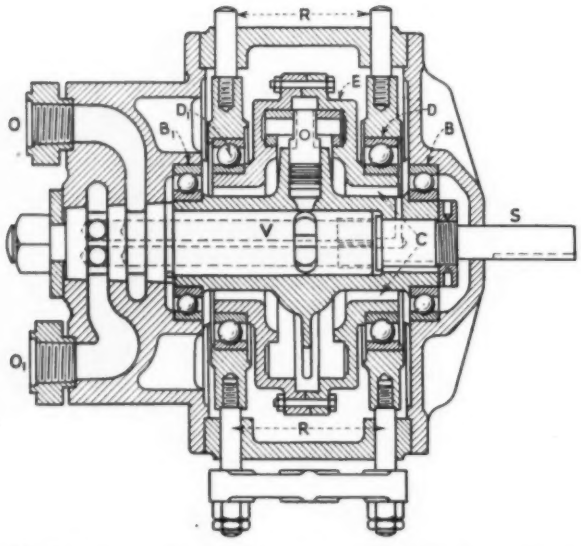
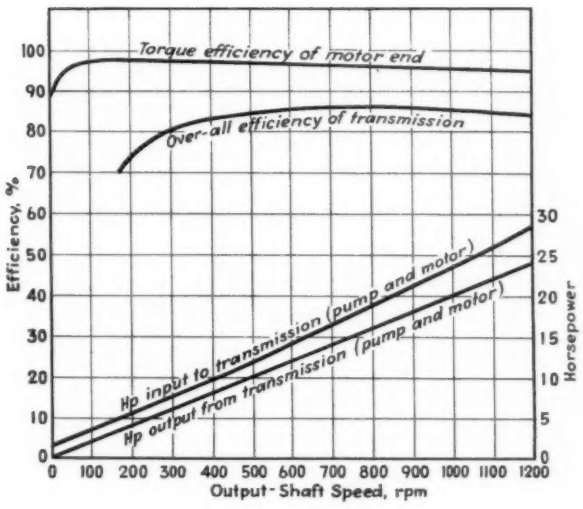


14

12, 13, 14 Radial-piston variable-speed transmissions usually have a separate pump and fluid motor, which have several radial cylinders and pistons that rotate about a fixed central cylindrical valve, or pintle, as shown



15 Horizontal section through a variable-displacement pump showing how piston-assembly position is adjusted


Torque efficiency of motor end
Over-all efficiency of transmission
Hp input to transmission (pump and motor)
Hp output from transmission (pump and motor)
Efficiency, %
Horsepower
Output-Shaft Speed, rpm
0 100 200 300 400 500 600 700 800 900 1000 1100 1200
0 10 20 30 40 50 60 70 80 90 100
0 5 10 15 20 25 30

16 Performance curves show characteristics of a typical radial-piston variable-speed hydraulic transmission

are on suction stroke. Below the horizontal center line, the pistons move toward valve *V* and are on discharge stroke, as indicated by the arrows.

Fluid motor operation is similar to that of the pump. Assume Fig. 13 to be a motor, and that a pump is supplying fluid under pressure to its bottom cylinders and drawing fluid from its top cylinders. Pressure on the pistons below the horizontal center line causes them and the cylinder assembly to rotate clockwise.

Reversing fluid flow from the pump puts the motor pistons above the horizontal center line under pressure and those below on discharge to change direction of motor rotation. Therefore, to reverse the motor it is only necessary to shift the pump's floating-ring assembly center of rotation from one side to the other of valve *V*'s center.

Amount of eccentricity of piston and floating-ring assembly with respect to the cylinder body determines pump's stroke length and, consequently, discharge volume. The latter can be controlled in infinitely small variations from zero to maximum to produce a corresponding change in motor speed. Maximum motor speed practically equals that of the pump.

Fig. 15 is a horizontal cross-section through a variable-displacement pump. Central cylindrical valve *V* has four holes parallel to its axis, as shown in Fig. 12 to 14. Two of the holes connect with intake ports and two with discharge ports at each end of the valve. The left-hand end cover of the pump rigidly supports valve *V* and the ports connect to intake and discharge, *O* and O_1. Either of these openings may be discharge or intake depending on the piston's center-of-rotation position relative to that of the cylinder body, as previously explained.

Bearings *B* and B_1 in the pump's end covers support the cylinder body and hold it in a fixed rotational position, relative to the central cylindrical valve. Pistons and their floating ring are supported in bearings *D* and D_1 and can be moved horizontally on guide rods *R*. Clearance *C* around cylinder support permits displacing the piston's center of rotation from that of the cylinder assembly, which is fixed by the input shaft. When the driving motor turns shaft *S*, the cylinder body, piston and inclosing case *E* turn with it to cause the pump to function as explained in Fig. 12 to 14.

Fig. 16 shows the performance curves of one design of radial-piston variable-speed transmission. This unit has an over-all efficiency as high as 86%. Its motor is of the constant-torque type, maximum torque being available at all speeds. Consequently, maximum horsepower transmitted is directly proportional to motor output speed. Power input to the pump is also proportional to motor-shaft speed.

This type of variable-speed transmission is built by three different companies, but all designs operate on the same general principle, their chief difference being in structural details. All can be arranged for direct manual control by a hand-wheel-operated screw, or for remote manual or automatic control by hydraulic and electric devices. Pressure devices provide automatic power and torque control.

Variable-speed hydraulic transmissions of both the parallel- and radial-piston designs have a wide range of applications. They include stokers of all types, forced- and induced-draft fans, paper-mill machinery, car dumpers, windlasses and milling machines.

ACKNOWLEDGMENTS

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SAVE COAL TO SPEED VICTORY

BECAUSE

1. 1945 coal production will fall an estimated 40,000,000 tons short
2. And not more than 15,000,000 tons more can be obtained from coal piles
3. Which leaves approximately 25,000,000 tons to be saved by you and me
4. Unless war production and war transportation are to be stalled
5. For weapons cannot be made or moved without coal and its products

SO LET'S ALL BACK OUR FIGHTING MEN BY SAVING COAL THESE WAYS

1. Never heat rooms over 68F
2. Never open windows when heat is on
3. Use hot water sparingly
4. Don't burn lights needlessly
5. Don't let motors run uselessly
6. Save gas; it's made from coal
7. Save oil; it replaces coal
8. Save all services made from coal, particularly water, compressed air, refrigeration, process steam

AND FINALLY...

Please practice these savings in your own home

(Signed)_____ Engineer

_____ Manager

Diesel Jacket Water Supplies Hydroblast, Saves $17,000 Yearly

► AN INTERESTING APPLICATION of waste-heat recovery from diesel engines at the Grove City plant of Cooper-Bessemer Corp., engine builders, shows estimated savings of about $17,000 per year. Jacket water from engines in the factory power plant supplies a hydroblast unit in the foundry, eliminating need for heating water by gas.

In the hydroblast unit, jets of warm water carrying abrasive particles scour rough castings to remove mold sand, cores, etc. In normal practice, such a unit would be equipped with a fuel-fired instantaneous heater. Here the fuel would have been gas and the heater would have been required to raise the temperature of 160 gpm of well water from 50 to 90 F. On the assumption that guns in the hydroblast booth would be in operation about two thirds of the time, gas consumption would have been 69,800 cu ft per day. At $0.65 per 1000 cu ft, cost of heating would have come to approximately $45 per day.

In estimating cost of operating the hydroblast, it was also necessary to take account of pumping charges. No data was available on cost of water from the plant wells and so, for purposes of analysis, the basic cost at the borough pumping station, $0.07125 per 1000 gal was used. At the 160-gpm rate, pumping cost would be $10.95 per day, giving a total cost of supplying heated water to the hydroblast of slightly more than $56 per day.

Experiments conducted in the plant powerhouse showed that there was a minimum discharge from heat exchangers to sewer of 350 gpm and that on most days the amount ranged from 430 to 450 gpm. Temperature of the water was in the neighborhood of 120-125 F.

It was accordingly suggested that this water be piped to the hydroblast unit in the foundry and that the gas-fired heater be sold to offset the cost of piping re-arrangement. It was further proposed that the supply line be extended to the north end of the pattern storage building to effect a saving in gas required to heat water for the shower room. For the sake of simplicity, estimates were drawn up considering savings in operation of the hydroblast only, allowing the cost of installation of a pump, tank and controls to be charged against this unit.

Since the water must be used in the powerhouse in any case, no pumping from the wells was necessary and cost of water was omitted from estimates. Equipment and installation cost was figured at $4125.00, on the basis of using two motor-driven pumps and 4-in. piping. Actual cost, with only one pump and 6-in. piping, came to $3743.22, itemized as follows:

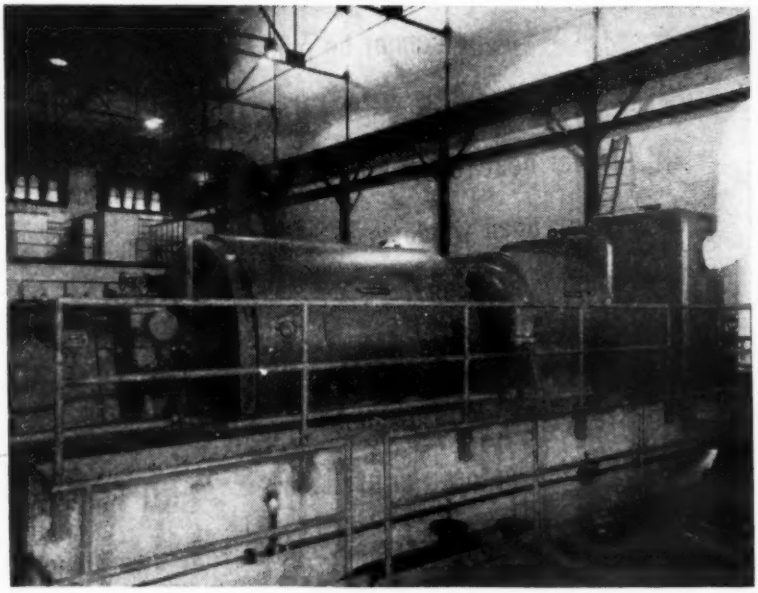
Pump	$301.09
Motor, 20-hp	From stock
Controls	263.58
Starter	137.75
Pipe (6-in.)	707.22
Covering	341.76
Tanks (one 500-gal water) (one 50-gal air)	From stock
Valves	206.27
Labor and misc	1785.55
Total	$3743.22

The only operating cost chargeable against the heat-recovery scheme was the power consumed by the 20-hp motor on the pump. Assuming operation at capacity, the power requirement would be 298 kwhr per day and, at $0,0101, plant cost of electricity, total cost would be $3.01 per day.

Thus the differential in operating cost between pumping and heating fresh water and using waste warm water from the diesels figured to a little more than $53 per day, or a net saving of $17,350 in operating costs the first year. Allowing $2000 refund on the gas-fired heater, the net cost of installation of waste-heat recovery ($1750) would be paid out of savings in about 35 days of operation.

On the basis of these calculations, the waste-heat installation was made. The hydroblast unit is now in full operation at the Grove City foundry and results appear to justify fully the decision to utilize diesel jacket heat.

AFTER YOU, UNCLE JOE!



New Hampshire Gas & Electric Co has just installed a new 7500-kw 650-psi 825-F 1800-rpm Westinghouse condensing turbine-generator in its Daniel Street Station, Portsmouth, replacing an earlier unit of this rating which was diverted to Russia in the previous stages of the war to help meet critical needs for electric power in the Soviet Union. A Combustion stoker-fired boiler supplies steam to this new machine, which raises station nameplate rating to 24,500 kw and permits favorable base-load operation

Ultimate Analysis from Proximate: a New Method

*Glenn C Boyer, associate engineer, Burns & McDonnell Engineering Co, shows how to convert proximate coal analysis into ultimate, with sufficient accuracy for combustion calculations like those explained in his articles on sure-fire forms for combustion engineering**

▶PRECISE COMBUSTION CALCULATIONS require an ultimate analysis of the coal, but ultimate analyses are costly, so it often happens that only the proximate analysis is available. This situation strongly suggests a search for some method of deriving an ultimate analysis from the proximate.

Ultimate analysis breaks the coal down into its constituent chemical elements—percentages by weight of carbon, hydrogen, oxygen, sulphur and nitrogen. The ash, however, is normally reported as such, not in terms of its elements.

The proximate analysis, on the other hand, does not report the composition in terms of elements, but as percentages by weight of moisture, volatile matter, fixed carbon and ash.

Either type of analysis is ordinarily accompanied by a report of the heating value in Btu per pound.

Heating value, proximate analysis and ultimate analysis may be reported for the coal "as received" or for the coal "ash and moisture free".

Let us study the nature of proximate and ultimate analyses to seek some reasonable basis for converting one to the other. This may require a little unorthodox reasoning and some unorthodox algebra. The first unorthodox equation reads:

Proximate analysis = *Ultimate analysis* (1)

You may say this cannot be, but when you consider that the two analyses are made on the same fuel and that everything reported in the proximate analysis must also be accounted for in the ultimate analysis, the foregoing isn't exactly crazy.

Restating equation (1) in different form, we get:

Moisture + Volatile matter + Fixed carbon + Ash = Carbon + Hydrogen +Oxygen + Sulphur + Nitrogen + Ash (2)

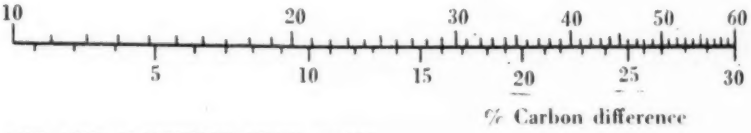
The ash, constant in both the proxi-

*Jan, 1945, Power, p 15: 1—Solid and Liquid Fuels; Feb, 1945, p 110: 2—Gas Fuels

1 Ultimate from Proximate Analysis

FUEL:

Proximate analysis:	As received	Ash and moisture free
Fixed carbon	(A)	(W)
Volatile		(X)
Moisture H_2O	(B)	
Ash		
	1.000	1.000
Sulphur		(Y)
Btu per lb		(Z)
% Volatile		



ASH-AND-MOISTURE-FREE BASIS:

(1) Conversion factor (from chart) =
(2) Total carbon = (W) + (1) =
(3) $H_2 = \dfrac{(Z) - [4000(Y)+14100(2)]}{61{,}100} =$

(4) (O+H)=1.000−[(Y)+(2)+(3)+0.014] =

(5) O_2 = 8/9(4) =
(6) Total H_2=(3) + [(4)−(5)] =

AS-RECEIVED BASIS:

(7) O_2 (In H_2O) = 8/9(B) =
(8) H_2 (In H_2O) = (B)−(7) =
(9) Correction factor = (A)/(W) =

Element	% Ash and moisture free	Correction factor	Percent corrected	Add moisture	Ultimate as received
	(a)	(9)	(b)=(a)(9)	(c)	d=b+c
Carbon C	(2)				
Hydrogen H_2	(6)			(8)	
Oxygen O_2	(5)			(7)	
Nitrogen N_2	0.014*				
Sulphur S	(Y)				
Ash					
			Total		

Copyright 1944 Glenn C. Boyer * Value assumed

Fig. 1—Blank form for computing ultimate from proximate analysis. Carbon in volatile matter is determined from carbon-hydrogen relation chart. This, plus fixed carbon, gives the total carbon. Rational formulas give "free" and total hydrogen

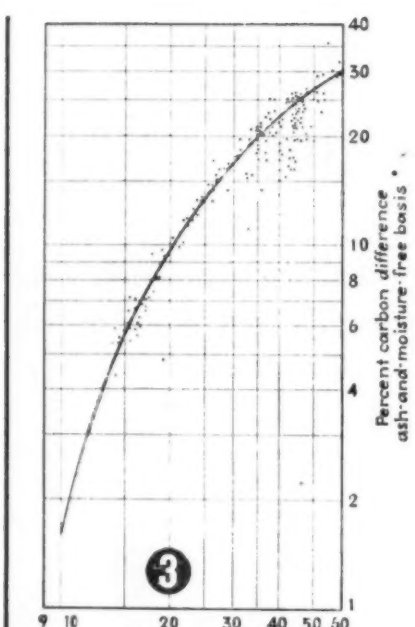


Fig. 3, *above*—Volatile plotted against carbon in volatile for 279 typical coals from 279 mines. Note consistency

Fig. 2, *right*—Computation form filled out for a sample of West Virginia coal

2 Ultimate from Proximate Analysis

FUEL: *Fayette-Kay Moor, West Virginia*

Proximate analysis:	As received		Ash and moisture free	
Fixed carbon	0.6881	(A)	0.733	(W)
Volatile	0.2511		0.267	(X)
Moisture H_2O	0.0317	(B)		
Ash	0.0291			
	1.000		1.000	
Sulphur	0.0052		0.0056	(Y)
Btu per lb	14,584		15,520	(Z)
% Volatile				

10 20 30 40 50 60
5 10 15 20 25 30
% Carbon difference

ASH-AND-MOISTURE-FREE BASIS:

(1) Conversion factor (from chart) = 0.145

(2) Total carbon = (W) + (1) = 0.733+0.145=0.878

(3) $H_2 = \frac{(Z) - [4000(Y)+14100(2)]}{61{,}100} = \frac{15{,}520-[4{,}000(.0056)+14{,}100(0.878)]}{61{,}100} = .0508$

(4) (O+H) = 1.000−[(Y)+(2)+(3)+0.014] = 1-[.0056+.878+.0508+.014] = .0516

(5) O_2 = 8/9(4) = 8/9 (.0516) = .046

(6) Total H_2 = (3) + [(4)−(5)] = .0508+.0516−.046 = .0564

AS-RECEIVED BASIS:

(7) O_2 (In H_2O) = 8/9(B) = 8/9 (.0317) = .0282

(8) H_2 (In H_2O) = (B)−(7) = .0317−.0282 = .0035

(9) Correction factor = (A)/(W) = .6881/.733 = 0.939

Element	% Ash and moisture free	Correction factor	Percent corrected	Add moisture	Ultimate as received
	(a)	(9)	(b)=(a)(9)	(c)	d=b+c
Carbon C	0.878 (2)	0.939	0.8250		0.8250
Hydrogen H_2	0.0564 (6)	0.939	0.0530	.0035 (8)	0.0565
Oxygen O_2	0.046 (5)	0.939	0.0432	.0282 (7)	0.0714
Nitrogen N_2	0.014*	0.939	0.0132		0.0132
Sulphur S	0.0056 (Y)	0.939	0.0052		0.0052
Ash					0.0291
			Total		1.0004

Copyright 1944 Glenn C. Boyer * Value assumed

mate and ultimate analyses, can be eliminated from further consideration at this point.

Now let's do a little more sleuthing. We know that the volatile matter is largely hydrocarbons, and consequently we can immediately say that:

Total carbon (ultimate analysis) = Fixed carbon (proximate analysis) + Carbon in volatile matter (proximate analysis) (3)

If we can find some relationship between the volatile matter and the carbon it contains, it will then be possible to determine the total carbon from the proximate analysis. This search requires that both proximate and ultimate analyses be available for each coal sample studied. Furthermore, all calculations are best made on an ash-and-moisture-free basis.

For example, consider a West Virginia coal with a proximate analysis and total carbon, as follows:

Type of analysis	*As received, %*	*Ash-and-moisture free, %*
Proximate:		
Fixed carbon	68.81	73.3
Volatile	25.11	26.7
Ash-and-moisture	6.08	
	100.00	100.00
Ultimate:		
Total carbon	82.59	88.0

In this tabulation ash and moisture total 6.08%, so ash-and-moisture-free coal weighs 100 − 6.08 = 93.92% of the weight of coal as received. Therefore the figures in the "as received" column, divided by 0.9392, give those in the ash-and-moisture-free column.

If we compare both analyses on the ash-and-moisture-free basis, the difference between the total carbon and the fixed carbon is seen to be 88.0 − 73.3 = 14.7%. This 14.7% is not in the fixed carbon so must be in the 26.7% volatile matter.

The author made this calculation for 279 coals from 279 different mines in the several coal-producing areas of the United States and Alaska—coals for which both ultimate and proximate analyses were known. In Fig. 3 each point represents one of these tests. The curve gives the average relationship between the percentage of volatile in the coal (ash-and-moisture-free basis) and the carbon in that volatile expressed as a percentage of the ash-and-moisture-free coal.

Note that the greatest divergence of individual tests from the curve occurs when the volatile exceeds 30%. However the possible final error in using the curve is much less than might be imagined from a casual study of Fig. 3 because the variation here applies only

to the "volatile carbon," which is much less than half of the total carbon.

The volatile matter in the proximate analysis consists of carbon, hydrogen, oxygen, sulphur and nitrogen. Most coals contain about 1.4% nitrogen on an ash-and-moisture-free basis. This value will be used for ultimate analysis calculations. The sulphur content of the fuel is generally reported with the proximate analysis.

The process of splitting up the volatile matter into its chemical components now becomes a matter of elimination.

The total carbon is the sum of the fixed carbon of the proximate analysis and the carbon in the volatile determined from Fig. 3. Nitrogen is estimated, and sulphur is known from the proximate analysis.

The only unknown is the ratio of hydrogen to oxygen in the remainder of the volatile. The hydrogen will be partly combined with the carbon in the volatile and partly with the oxygen. That combined with the oxygen has no available heat. That combined with carbon contributes its full quota of heat, along with the carbon and sulphur.

The form presented in Fig. 1 gives space, data and directions for each step in converting a proximate analysis to an ultimate. Fig. 2 works an actual case for a West Virginia coal.

The first step is to enter the proximate analysis in the "As Received" column. Next convert the as-received analysis to an ash-and-moisture-free analysis.

The conversion line chart, immediately below the proximate analysis, and based on Fig. 3, gives the carbon in the volatile (ash-and-moisture-free). This is marked "percent carbon difference," as in Fig. 3, because it is the difference between the fixed carbon and the total carbon.

The percent carbon difference from this chart is entered as item (1). Item (2), total carbon, is the sum of (W), the fixed carbon (ash-and-moisture-free basis) and item (1), the carbon in the volatile.

Next figure the hydrogen in the hydrocarbon form, using the formula in item (3). Here the heat contributed by the carbon and the sulphur is subtracted from the heat of the fuel to give the heat supplied by the hydrogen. Divided by 61,100, the heat value of hydrogen, this gives the content of burnable hydrogen.

Item (4), *combined* hydrogen and oxygen, is the remainder of the fuel, and is calculated by subtraction.

Item (5) is for calculating the oxygen in item (4). Item (6) is total hydrogen in fuel, ash-and-moisture-free.

Next break down the moisture in the as-received analysis into its oxygen and hydrogen in items (7) and (8). Then compute item (9), "Correction factor," necessary for the final steps in converting the ultimate analysis from the ash-and-moisture-free to the as-received basis.

Now we come to the final steps, using the form at the bottom of Fig. 2. Enter the values for items (2), (6), (5) and (Y) in column (a). Enter the correction factor, item (9) in all five blank spaces in column (9).

To obtain the corrected values for column (b) multiply the values for column (a) by correction factor, item (9).

Enter values for items (8) and (7) in column (c). Add the corrected values of hydrogen and oxygen, column (b), and put the totals in column (d).

Values for carbon, nitrogen and sulphur in column (b) are carried over to column (d). The value for the ash is taken from the proximate analysis, as

(*Continued on page* 178)

Table I—Ultimate from Proximate Analysis

COAL-PRODUCING AREA		PROXIMATE ANALYSIS						ULTIMATE ANALYSIS			
		Fixed Carbon	*Volatile*	*Moisture*	*Ash*	*S*	*Btu*	*C*	H_2	O_2	N_2
W. Va. (1)	Actual	75.25	13.91	2.19	8.65	0.57	13,995	80.69	4.45	4.45	1.19
	Calc							80.00	4.84	3.80	1.23
	Diff							0.69	0.39	0.65	0.04
Pa.	Actual	73.16	16.18	3.44	6.92	1.83	14,114	80.61	4.61	4.80	1.20
	Calc							79.70	4.62	5.70	1.25
	Diff							0.91	0.02	0.90	0.05
W. Va. (2)	Actual	68.81	25.11	3.17	2.91	0.52	14,581	82.59	5.09	7.26	1.63
	Calc							82.50	5.65	7.14	1.32
	Diff							0.09	0.56	0.12	0.31
W. Va. (3)	Actual	59.94	32.89	1.66	5.51	0.93	14,126	78.97	5.16	8.17	1.26
	Calc							78.60	5.98	7.74	1.30
	Diff							0.37	0.82	0.43	0.04
Alaska (1)	Actual	43.99	30.37	10.77	14.87	0.70	9,641	55.26	4.98	23.57	0.61
	Calc							61.10	3.67	18.65	1.04
	Diff							5.84	1.31	4.92	0.43
Iowa	Actual	39.37	35.59	14.08	10.96	4.26	10,723	58.49	5.57	19.82	0.90
	Calc							58.80	6.11	18.86	1.05
	Diff							0.31	0.54	1.04	0.15
N. Dak. (1)	Actual	29.97	28.16	36.78	5.09	0.48	7,204	41.87	6.93	44.94	0.69
	Calc							45.20	6.70	41.80	0.80
	Diff							3.33	0.23	3.14	0.11
N. Dak. (2)	Actual	25.35	29.77	36.18	8.70	0.68	6,700	39.45	6.76	43.82	0.59
	Calc							41.00	6.33	42.55	0.77
	Diff							1.55	0.43	1.27	0.18
Ky. (1)	Actual	38.75	18.40	2.36	10.49	1.20	13,770	71.98	6.47	8.70	1.16
	Calc							64.90	9.11	13.15	1.22
	Diff							7.08	2.64	4.45	0.06
Ky. (2)	Actual	59.42	30.01	3.73	6.84	0.56	13,649	76.30	5.07	10.17	1.06
	Calc							76.10	5.87	9.31	1.25
	Diff							0.20	0.80	0.86	0.19
Ill.	Actual	55.10	27.66	11.82	5.42	0.46	11,961	67.87	5.44	19.47	1.34
	Calc							70.50	5.46	17.00	1.15
	Diff							2.63	0.02	2.47	0.19

Table II

Comparative Combustion Data

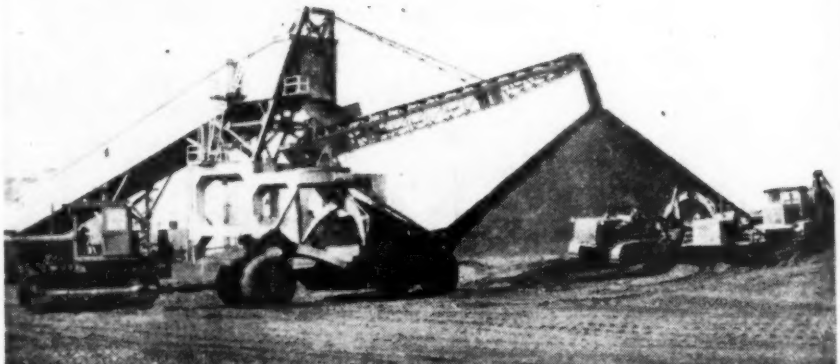
	Weight theoretical air lb	*CO_2 theoretical air %*
ALASKA (1)		
Actual ultimate analysis	7.08	19.15
Calc ultimate analysis	7.51	19.70
Difference	0.46	0.55
KENTUCKY (1)		
Actual ultimate analysis	9.88	17.42
Calc ultimate analysis	10.22	16.20
Difference	0.31	1.22

Mobile Units Handle Big Coal-Piling Job At Polymer Corp Synthetic Rubber Plant

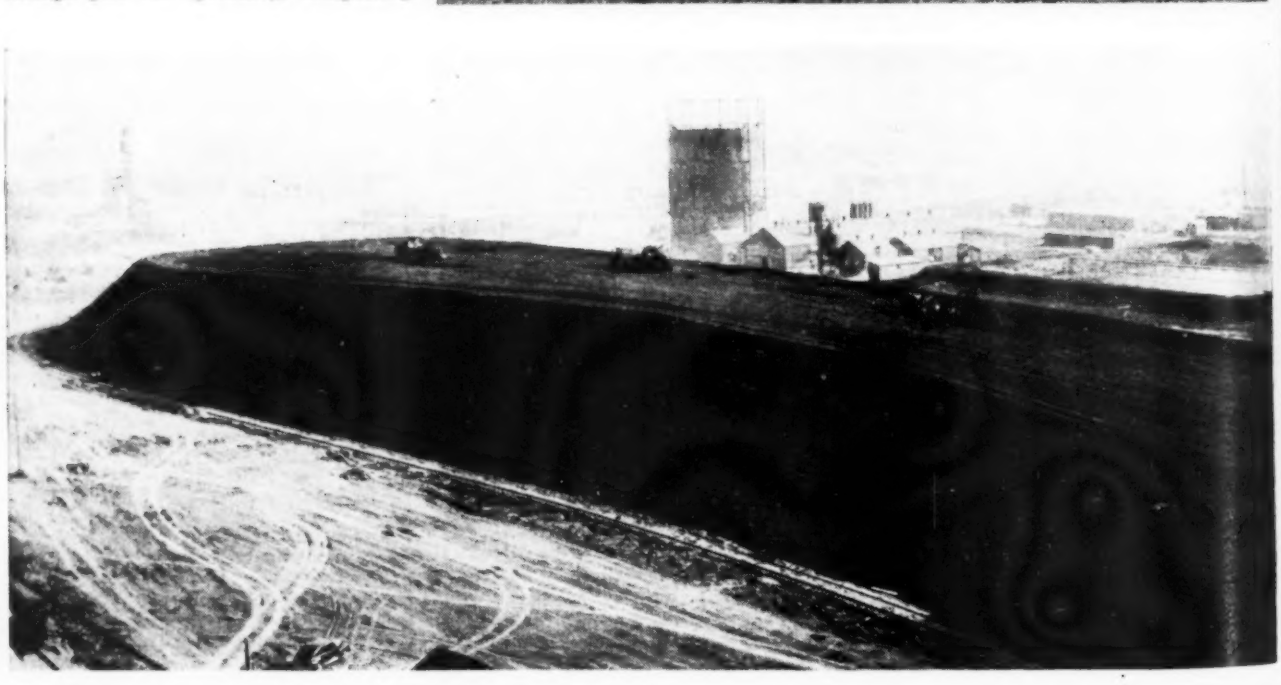
► MOBILE EQUIPMENT for hauling and piling coal at the synthetic-rubber plant of Polymer Corp, Ltd, at Sarnia, Ontario, Canada, produces a compacted and, therefore, safe storage pile with minimum investment.

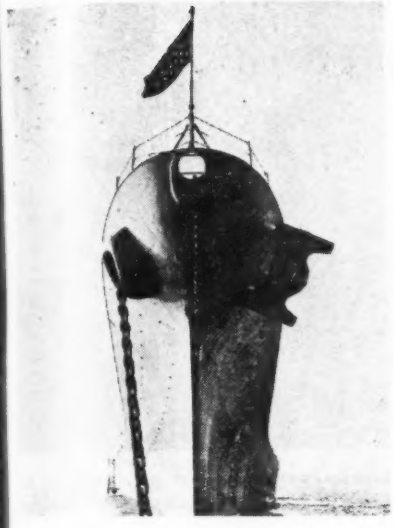
Original plan called for construction of an overhead bridge system but decision to change to mobile units was made after comparison of costs. The present system, shown in photos, consists of a belt conveyor which takes coal from the unloading dock, where it is received by boat, to a swinging stacker boom. The stacker unloads into ground piles at a 1000-ton-per-hr rate. Three LeTourneau carryall scrapers, of 15-heaped-yards capacity, haul coal to the storage pile, which is about 400 ft wide, and 1500 ft long. The tractors and rubber-tired carryalls spread coal in thin layers and normal travel across the pile compacts it.

Although equipment can handle larger tonnage, last year's pile held about 300,000 tons. There were no signs of overheating. Mobile units were first used in construction of the plant.



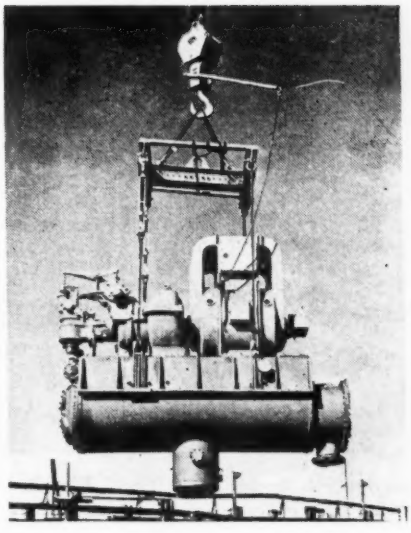
Conveyor takes coal from unloading dock, upper photo, to swinging stacker, shown in closeup, center. Carryall scrapers load at pile thus formed and haul to storage pile for spreading, compacting





Most devastating instrument of destruction ever devised, battleship of the Iowa class rates upward of 200,000 shp. plus 10,000-kw electrical auxiliaries

American Armada Supplies Allied Armies



Twin-screw turbine-electric troopships need two of these 3500-hp packaged, condensing power units, 4800 rpm at 80 cycles. *Kaiser-Walsh photo by Norman Ray*

U. S. Navy now has more installed horsepower than all land plants within the country; land, sea and amphibious fighting power depends on supplies brought by cargo ships and tankers of merchant fleet and Navy fleet train

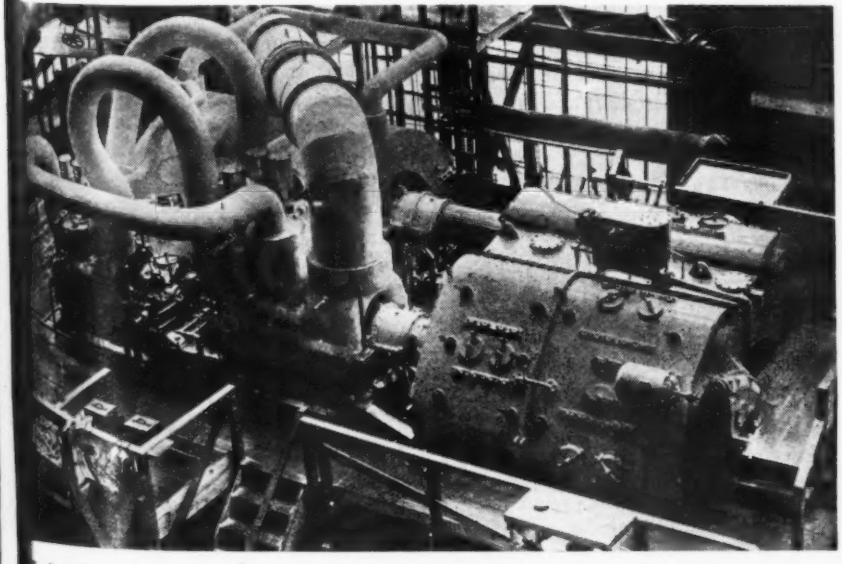
▶CUTTING THE land power-plant program to the bone in 1942 seemed at the time to involve a considerable risk of electric-power shortage. Fortunately, baling wire, patches and general good luck have held, and the several million kilowatts of turbines and other power equipment that would have been bought as insurance against home trouble are now contributing directly to military successes in the Navy, its supply train and the globe-girdling merchant marine.

Wartime developments in ship propulsion can be expected to bring handsome dividends to stationary power operators in years to come. Specifically, steps toward mass production of turbines, boilers and diesel engines have accomplished a certain amount of standardization which will have a limited but definite effect on land plants. Furthermore, research in metals, design and manufacturing processes has advanced at an accelerated pace with results already visible that mean better land power equipment for less money.

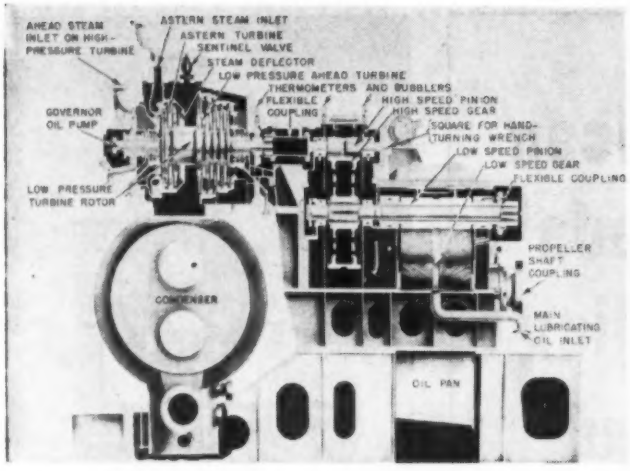
To review progress briefly, note that the Navy now has more horsepower afloat than all combined utility, government, municipal and industrial plants in the country. More than half the Navy power is accounted for by internal-combustion engines but larger ships are steam-turbine or turbine-electric drive except certain smaller aircraft carriers that are reciprocating steam driven.

Battleships of the Iowa class have high-pressure (even by stationary-plant standards) steam turbines aggregating more than 200,000 hp in four geared units and 10,000 kw of auxiliary power in eight turbine-generator sets. Cruisers and aircraft carriers account for a large number of only slightly smaller turbine sets. General Electric alone produced more than 7,800,000 hp in main propulsion turbines of all classes in 1944 and this was only 10% above the 1943 figure.

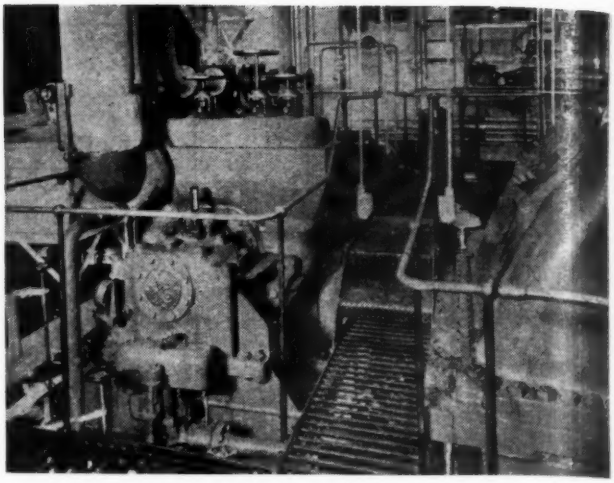
Details of Navy special-purpose craft such as the LST and LSM, as well as supply and troopships, are still restricted, but already some indications of newly developed equipment and arrangements have been released. For example, a 3500-hp packaged power plant by Westinghouse for turbine-electric troopships is complete with



Each of more than 15 Essex-class carriers has four of these Westinghouse cross-compound geared turbines with astern blading capable of high speeds in combat



Section of model of General Electric 6000-hp set for Victory ship; port-side view shows low-pressure and astern turbines, condenser, low-pressure side of gear trains and auxiliaries



Engine-room view of 8500-hp geared-turbine set, such as installed on some of the Victory ships. High-pressure turbine is at left, low-pressure is at right

auxiliaries when shipped from the factory, and General Electric reports higher interrupting capacity and shock-proofness for certain types of circuit breakers developed for Navy.

The merchant-ship program, at the end of 1944, included some 2500 Liberty ships, more than 400 "C" type vessels, about 500 oceangoing and coastal tankers, and approximately 100 Victory ships. These, together with a number of special-purpose craft aggregate 50 million tons, four times that of our prewar fleet and perhaps two thirds of all tonnage afloat in the world.

According to Vice-Admiral Emory Land, Chairman of Maritime Commission, this country will have all the elements needed to restore its eminence as a maritime nation after the war emergency has passed. He believes that we can find use for 15 to 20 million deadweight tons of the merchant fleet for peacetime trade including coastwise, lake and other domestic transportation. This fleet would include most of the turbine and diesel vessels leaving the Liberty ships to be disposed of or maintained as a reserve fleet.

Except for the Liberty ships, which were admittedly designed for war needs alone, practically all other vessels can hold their own in commercial cargo service. The Victory type, for example, does 16½ knots compared to the Liberty's 11 limit. Using 440-psi 740-F steam, the Victory 6000-hp (VC2-S-AP2) and 8500-hp (VC2-S-AP3) propulsion units are competitive in efficiency with other steam-driven vessels and afford a cruising range of 20,000 miles.

The 6000-hp unit represents a coordinated design of turbine manufacturers so that any turbine and any gear can be installed in the hull of any ship with only minor differences in bolting. Principal shipyard piping connections are at the same locations.

The 5500-rpm high-pressure turbine has five stages while the 4000-rpm low-pressure rotor mounts five ahead stages and two astern disks with a double-row impulse on the first disk. Condenser is suspended from the low-pressure casing exhaust flange with suitable bracing to prevent side sway. Double-reduction gear turns propeller shaft at 100 rpm.

Last but not least in interest to stationary power operators is the history of four 30,000-kw floating power plants originally intended as emergency backup for American power systems. Two of these have been converted for 50-cycle operation and have been in use by the Army in the European theater for some weeks. A third is now undergoing necessary modifications for similar use.

The fourth of these power barges, actually the first completed, served in Vicksburg, Miss., to help alleviate a tight local power situation, then was tied in with Gulf Power Co system at Pensacola, Fla., where it has served for the past year. It will soon proceed to Jacksonville, Fla., to help carry the municipal system load pending installation of new boiler equipment.

For foreign service, where 50 cycles is standard frequency, a 50-to-60-cycle frequency changer is added to drive auxiliaries while the main unit is slowed down to 50 cycles. In addition, turbine blading in the last stage is rearranged for the slower speed.

The hulls require minor strengthening for the ocean crossing as well as the addition of a bow, rudders, steering engine, light gun mounts, refrigeration, an additional evaporator, pilot house, compartments for more crew and a sick bay.

For operation in this country, these plants cost about $100 per kw and require 20-to-25 men for 3-shift operation. Modifications for overseas duty represent an additional cost and a crew of 65 men is required including military personnel. Two have been towed overseas at about nine knots and proved seaworthy.

Combined activity in improved ship-propulsion machinery and such war-born developments as these floating power units can be expected to be of enduring benefit to stationary power operators in postwar years.

HEAVY SNOWFALL MAY MEAN FLOODS

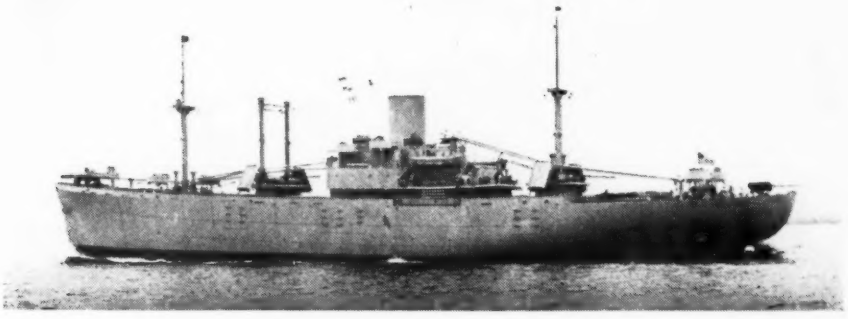
This winter's abnormal snows forecast potential flood trouble in many sections of the country. Power engineers in these areas undoubtedly are aware of the situation and are taking steps to avoid flood damage wherever possible and, where it can't be avoided, are planning how to restore full service as quickly as possible after flood waters recede.

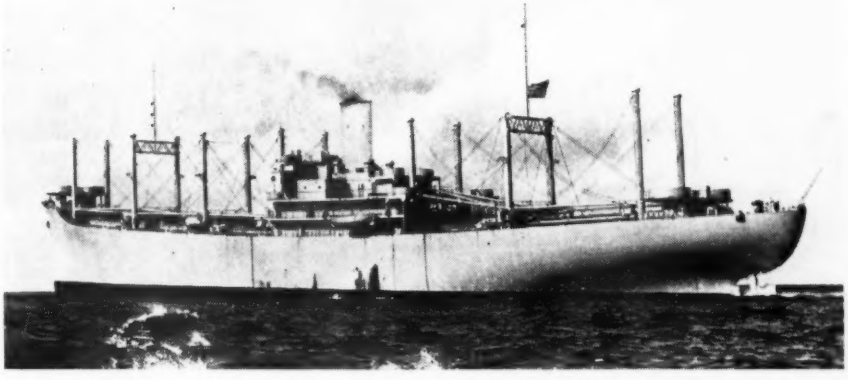
If you need information on reconditioning flooded power equipment, just drop a line to POWER. We will be glad to send you our own data sheets on drying-out procedures and to refer you to other sources.

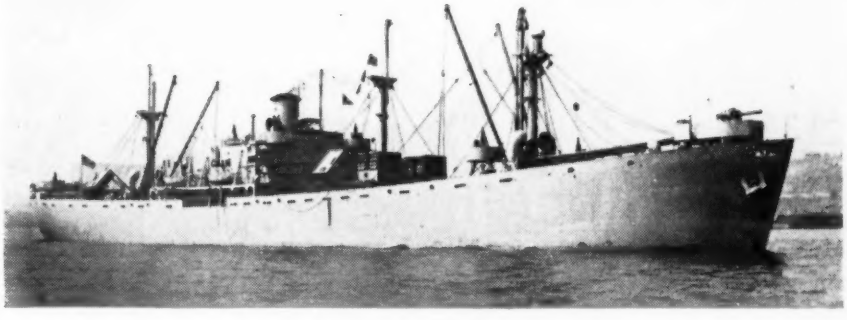
PRINCIPAL SHIP TYPES

Of World's Greatest Merchant Fleet

These basic designs of U. S. Maritime Commission were planned in detail before we entered 'shooting' war. Original program has been modified to suit varying needs



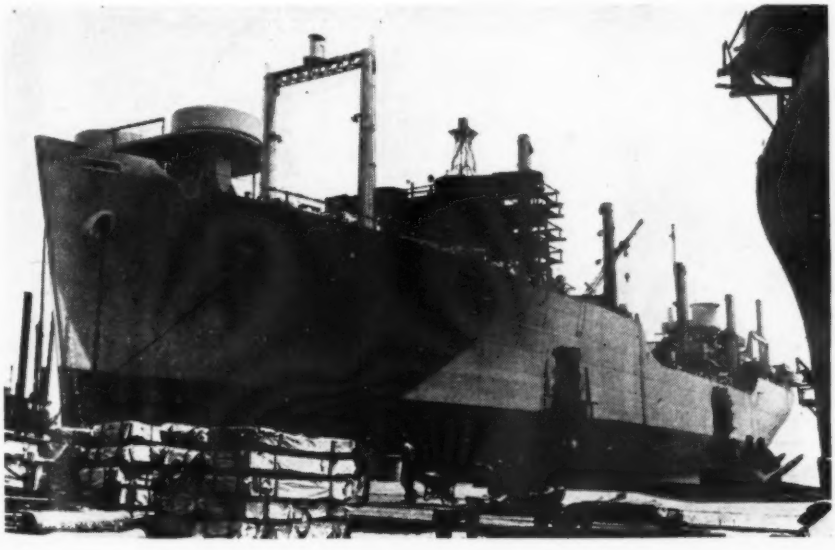




Official U. S. Maritime Commission photos

C1-A *(top)*—Smallest of three original ship designs for general cargo purposes, 412-ft length, 60-ft beam, 7416 tons dead weight. Propulsion: 4000 shaft hp by steam turbine or diesel

C3 *(second from top)*—Biggest and fastest of original trio, these ships will have a permanent place in America's merchant marine, 492-ft length, 70-ft beam, 12,929 tons dead weight. Propulsion: 8500 shp by steam turbine

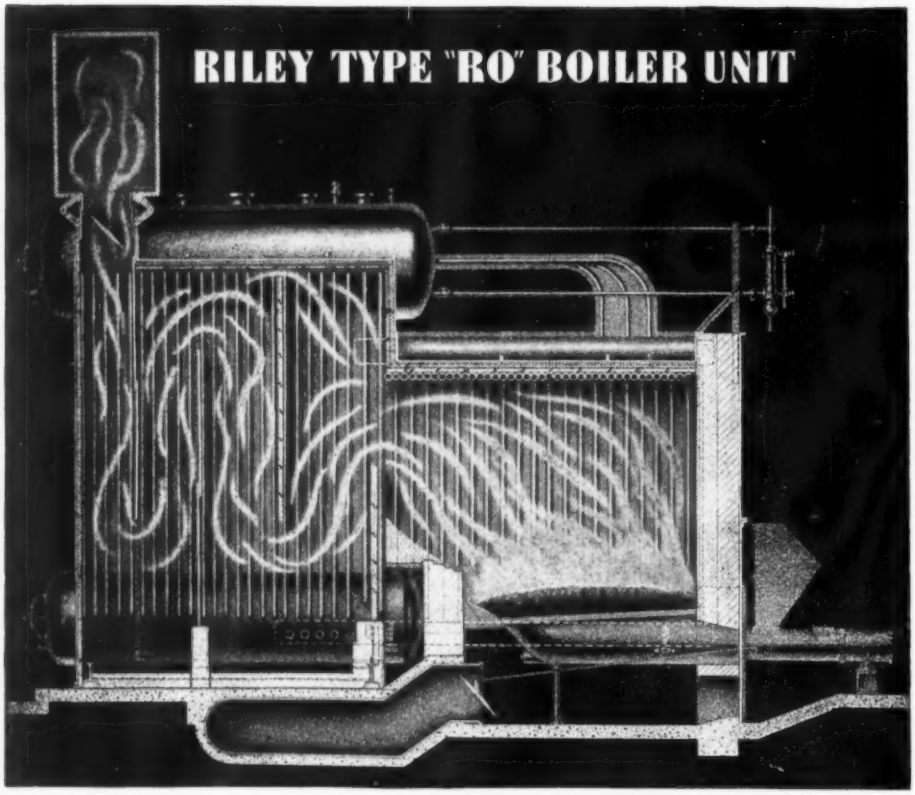


EC2 *(above)*—Work horse of World War II, well-known Liberty ship developed from original C2 designs for mass production; 442-ft length, 57-ft beam, 10,800 tons dead weight. Propulsion: 2500 shp by reciprocating steam engine

C4 *(left)*—Machinery installation at stern features newest vessel of cargo fleet. 523-ft length, 72-ft beam, 14,600 tons dead weight, and 15,000 miles cruising radius. Propulsion: 9000 shp by steam turbine

(Continued on page 98)

Dollar Logic Dictates the Use



FOR STEAM CAPACITIES UP TO 100,000 LBS. PER HOUR
Adaptable for Stoker, Pulverized Coal, Oil, Gas or Wood Firing

General Electric Co.
American Steel & Wire Co.
Standard Oil Co. of Calif.
Packard Motor Car Co.
Eagle Picher Lead Co.
Revere Copper & Brass Co.
Scovill Mfg. Co.
Mead Corp.
Pepsi-Cola Co.
U.S. Gypsum Co.
Armour & Co.
Behr-Manning Co.
Heyden Chemical Co.
Nunn Bush Shoe Co.
Great Western Sugar Co.
American Brass Co.
Curtiss-Wright Corp.
Monsanto Chemical Co.
The Bullard Co.
Nicholson File Co.
Goodyear Tire & Rubber Co.
Modine Mfg. Co.
Pet Milk Co.
Hercules Powder Co.
A. O. Smith Co.
Republic Creosoting Co.
Penn. Salt Co.
Wickwire Spencer Steel Co.
Grand Rapids Gas Light Co.
Publicker Comm. Alcohol Co.

Geo. O. Jenkins Co.—Oil fired.
Efficiency 83.4%, Flue Gas Temp. 465°F.
N. Car. Central Heating Plant—Stoker fired.
Efficiency 83.5%, Flue Gas Temp. 453°F.
Pet Milk Co.—Stoker fired.
Efficiency 85.2%, Flue Gas Temp. 482°F.
Seneca Knitting Co.—Stoker fired.
Efficiency 83.2%, Flue Gas Temp. 368°F.
Heyden Chem. Co.—Oil fired.
Efficiency 83.2%, Flue Gas Temp. 470°F.
American Hoist & Derrick Co.—Pulverized Coal fired.
Efficiency 84.1%, Flue Gas Temp. 378°F.
U. S. Naval Supply Depot—Pulverized Coal fired.
Efficiency 84%, Flue Gas Temp. 441°F.

When purchasing boilers, the best investment is the one that returns the greatest amount of money per dollar invested—almost invariably this is not the lowest priced proposition.

Such dollar and cent logic should dictate the proposition to be accepted by you—it has dictated the selection of Riley "RO" boiler units by so many of the country's leading industrial companies.

Fuel savings resulting from higher operating efficiencies together with negligible maintenance and continuity of gratifying operation more than justifies the purchase of Riley "RO" boiler units even though initial investment be higher.

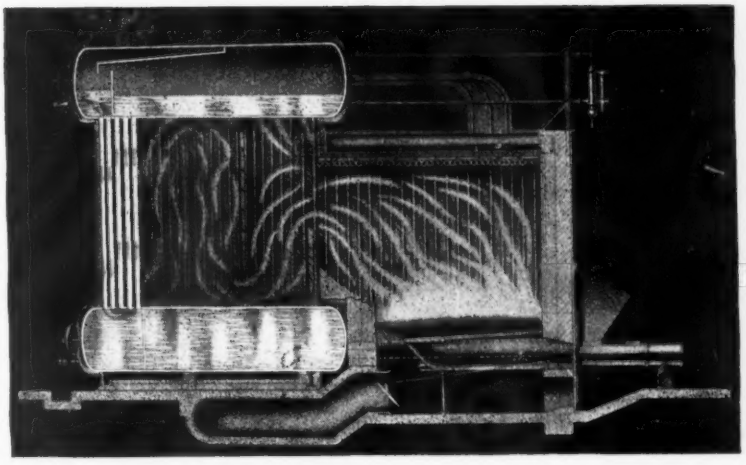
Due to the large hydrostatic head, resulting from the large distance between upper and lower drums, rapid positive circulation and, consequently, high heat transfer efficiency is obtained. This feature together with those mentioned on the opposite page explain the high operating efficiency of Riley "RO" boiler units.

RILEY

STOKER CORPORATION, WORCESTER, MASS.

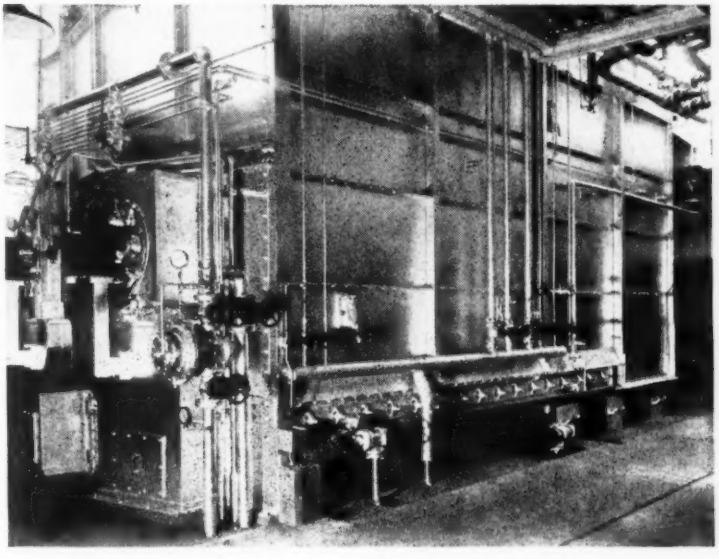
Boston New York Philadelphia Washington Buffalo Cleveland Detroit Chicago St. Louis Cincinnati
St. Paul Kansas City Denver Seattle Portland Los Angeles Houston New Orleans Atlanta Memphis

# of Riley "RO" Boiler Units



An economizer section at the rear of the unit forces the feed water to flow down and then up through a series of tubes before passing into the boiler. This results in higher efficiency because flue gas temperatures are lower and less heat goes up the stack.

Side walls and roof are water-cooled, affording a large percentage of radiant heat absorbing surface, resulting in lower furnace temperatures. Fuel burning equipment can be operated at maximum efficiency as clinker difficulties are prevented. Water walls also protect side wall refractories, practically eliminating refractory maintenance.



The steel clad casing, constructed of No. 10 gauge steel for rigidity, assures a permanently tight setting, preventing losses due to infiltration of cold air not only when new but always. It is not necessary to continually patch cracks against air leaks. The heavy blanket of insulation reduces heat losses through the setting to a minimum.

A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs

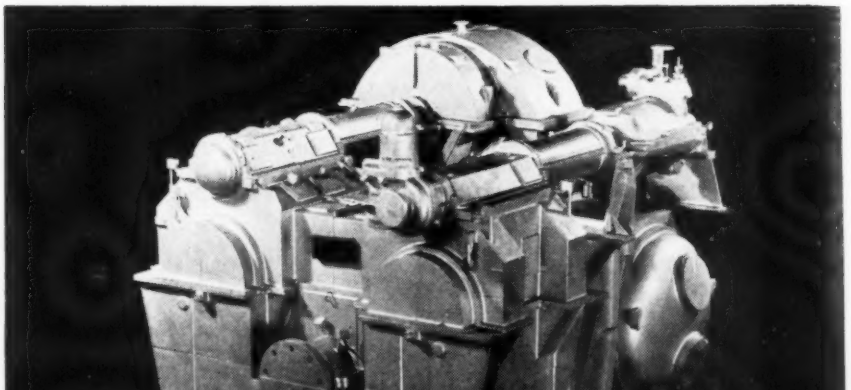
COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

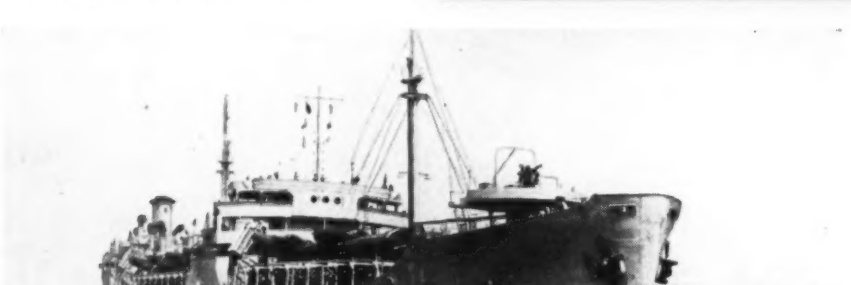
MERCHANT FLEET

(*Continued from page 95*)

These are good ships, good enough to hold their own in peacetime trade after emergency wartime demands have been met. **This time let's keep our merchant marine**

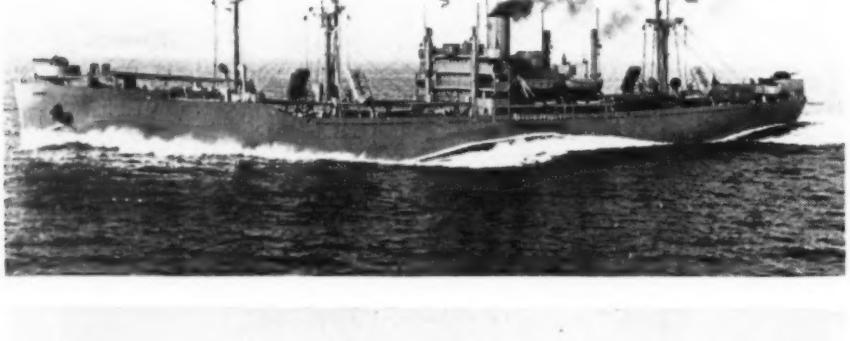


Official U. S. Maritime Commission Photos

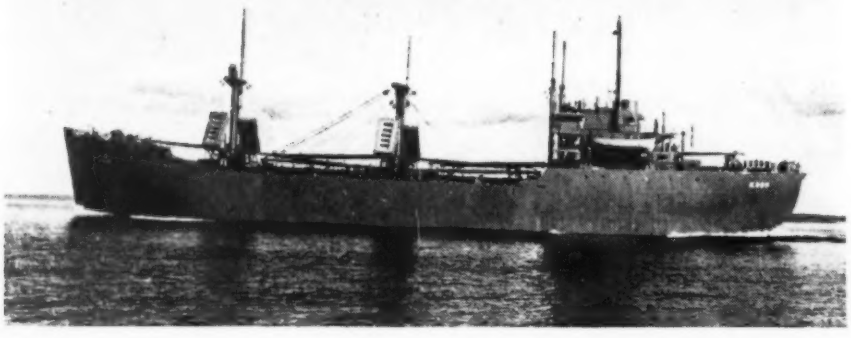


Model *(above)* of steam-turbine gear set for Victory ship comprising high- and low-pressure turbines, gear housing, condenser, turning gear and all ordinary auxiliaries. Units of all manufacturers fit all Victory hulls

T2—Tanker had to be turbine-electric drive because gear shops couldn't make enough for all, but that has been no handicap; 523-ft length, 68-ft beam, 30-ft draft, 16,765 tons dead weight. Shp 6000 by turbine-electric drive



VC2—Victory type takes over where Liberty leaves off, production-line built but faster. Length 455 ft, beam 62 ft, 10,850 tons dead weight. Some have 6000-shp standardized geared-turbine drive, others 8500 shp units



C1-M-AV1 Small cargo ship of recent design. Length 339 ft, beam 50 ft. 5000 dead-weight tons. Propulsion: diesel 1700 shp. Experimental gas turbine has been ordered for a single ship of this type

AMERICA WANTS COMPETITION

Only American Initiative Can Preserve It in World Trade

AMERICANS generally agree upon what constitutes a desirable pattern of international economic relationships. We want an expanding world trade, with minimum recourse to government-imposed trade barriers and discriminatory trading arrangements, and offering ample scope for competitive private enterprise. Because they are necessary to such trade, we want also stability of exchange rates, and national currencies that are mutually convertible at least for the settlement of current accounts. We want, too, arrangements to facilitate long-term capital loans with security to the lender and advantage to the borrower.

Few other nations subscribe to these aims with enthusiastic conviction. Some reject them flatly as impractical under the conditions likely to prevail during the postwar period, or achievable only at prohibitive cost to their domestic economies.

Unless, therefore, we can formulate a practical and comprehensive program to carry out our aims, and convince other nations that we will take a sustained and responsible part in making it effective, the international trade of the world surely will be conducted under a system of exchange controls, bilateral agreements, cartel bargains, import quotas, and direct government purchasing arrangements that are the very antithesis of the competitive system that we favor.

To agree upon a concrete American **program,** and to convince other nations that it is to their advantage as well as ours to accept it, is a major task of economic statesmanship. It entails reversing a trend which has persisted since World War I, and which has been intensified during the depression years of the nineteen-thirties and by the exigencies of World War II.

Clearly, that is not a task to be assumed lightly. We can hope to be successful only if (1) we have a deep conviction that what we seek is fundamentally important to the American interest, and (2) if we will take pains to understand why other nations fear that such a program may jeopardize their interests, and then make whatever accommodations may be necessary to resolve their doubts.

An expansive foreign trade policy has been advocated so vigorously and repeatedly in America recently that The Economist (of London) comments wryly upon what it terms the ironic circumstance that "the acceptance of the principles of free trade by the more literate (American) public should come at a time when the doctrines in their simplest nineteenth-century form have been pretty generally emasculated in fact and repudiated in principle by the rest of the world".

☆ ☆ ☆

Why are we opposed to managed world trade, and for competitive world trade?

First, we are against rigged and managed international markets because we know that successful participation necessitates a comparable degree of control over the domestic economy as well. There is little debate of this fact, and those nations which accept a managed external trade as a necessary protective measure are generally willing to pay the price in internal regimentation. We are not. For us to do that would be as alien to our genius as it is repugnant to our conviction.

Second, we believe that the United States will be able to compete successfully in world markets, even though we have, and intend to maintain, wage scales far higher than those of the nations whose competition we must meet.

There is impressive evidence to substantiate the soundness of this conviction:

1. Wage scales, of themselves, do not determine the competitive position. They are meaningful only when translated into labor costs, by dividing wage rates by units produced. **A recent War Production Board study shows that in manufacturing industries generally, during the period immediately before the present war, production per man hour in the United States exceeded that in the United Kingdom, Germany and Soviet Russia by a ratio of more than 2½ to 1, and that of Japan by more than 4 to 1.** When comparison is made with available wage data, it appears that our labor costs are generally on a competitive plane.

2. Perhaps the best evidence of our ability to compete in export markets is the record of our demonstrated capacity to do so in the past. **During the entire period between World Wars I and II, the United States consistently commanded a greater share of the world's export trade than any other nation,** although the United Kingdom took a larger percentage of world imports.

3. We have been particularly successful in world trade competition in the export of machinery, vehicles, a variety of manufactured specialties, and certain agricultural products. Except in the last-named field, there is every evidence that we enjoy genuine competitive advantage over other nations, and this advantage will have been increased rather than diminished by developments during the Second World War. It is noteworthy that the goods in which we have been able to compete most successfully have generally been the products of our high wage industries rather than those in which low wages have prevailed.

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It is clear that, on a price basis, we shall be able to compete successfully in postwar markets in numerous lines. It is equally clear that such an opportunity is by no means of negligible importance to our own economy as a whole. During the years in which the censuses were taken between 1909 and 1939, our exports amounted

to from 7 to 16 per cent of our entire production of movable goods. In the year 1938 our exports in each of the following lines accounted for more than 10 per cent of total domestic production of the particular product.

(The figures in parenthesis are the percentages of total production exported.)

CRUDE MATERIALS: Phosphate rock (51.5), cotton (30.5), tobacco (29.4).

FOODSTUFFS AND BEVERAGES: Linseed (49.4), dried fruits (36.2), canned sardines (29.4), rice (21.0), fresh pears (15.9), canned salmon (13.8), canned asparagus (13.2), canned fruits (13.0), wheat (12.2), lard (11.7).

SEMI-MANUFACTURES AND FINISHED MANUFACTURES: Refined copper (53.1), paraffin wax (46.3), gum turpentine (42.6), carbon black (40.8), gum rosin (38.0), borax (35.9), crude sulphur (35.6), aircraft and parts (26.8), office appliances (22.3), carbons and electrodes (21.8), printing and bookbinding machinery (18.2), agricultural implements and machinery (17.0), biologic pharmaceuticals (15.3), industrial machinery (14.4), dental instruments and supplies (14.3), automobiles (14.1), benzol (13.3), goat and kid upper leather (12.8), refined lead (12.0), radio apparatus (11.8), caustic soda (11.4), refined mineral oils (10.6).

It is of major concern to all engaged in these lines of activity and in many others that foreign markets be not closed to us. It is particularly to our interest to have export outlets for our war-expanded capital goods and equipment industries. Since we undertook an important percentage of such expansion in order to furnish munitions to our Allies, it is reasonable to ask their cooperation in cushioning what inevitably must be a drastic readjustment here. The case is strengthened by the fact that the postwar world will desperately need the equipment items that we, alone, can supply.

But our demonstrated ability to compete on a price basis will not, of itself, assure us of foreign market outlets. Transportation costs, quality of product, marketing skill, technical and repair service—all are basically important. Still more important are non-discriminatory open markets and the command of dollar exchange by prospective purchasers. Our export potentials will surely be cramped in a world organized on the basis of bilateral deals and exchange controls. The availability of dollar exchange must depend upon the level of American imports and the volume of American capital loans.

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How are we to explain the skepticism of other nations toward an order which to us seems so clearly to represent not only our interest but the long-range interest of the world as well?

Soviet Russia, of course, is committed to conducting its external trade through its central government. But what of the United Kingdom? Why are there so many British voices that counsel the abandonment of what has been Britain's traditional position for more than a century? If we can understand that, we shall understand the dissent from our position of most nations whose economic positions have weakened and whose fiscal problems have multiplied during the two World Wars and the ill-starred period between them.

Essentially, their case is this:

Partly, they were forced into managed external trade policies by the Axis self-sufficiency programs, adopted in preparation for aggressive war. That can be corrected only by crushing the Axis, and by establishing a world security system that will make self-sufficiency a less compelling need.

But primarily, the reluctance of peaceably inclined nations to forego restrictive controls over postwar foreign trade stems from a deep-seated fear that is even more difficult to resolve. They fear, on the basis of past experience, that their efforts to meet payment balances arising from normal foreign trade would force a deflation of their internal economies, affecting prices, credit, wages, and finally employment. Faced with the choice, as they see it, between making adjustments in foreign trade or in their domestic economies, they lean toward the former as, at worst, the lesser of two evils.

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Since the kind of world trade system we seek is dependent upon international arrangements to assure reasonable stability of exchange rates between national currencies, we are challenged to find a formula that both will provide this and at the same time allay what other nations believe are legitimate fears with respect to their domestic economies.

But at least two major steps toward resolving such doubts can be taken upon our own initiative without recourse to the intricate process of international negotiation.

One is the rational overhauling of our tariff system, to provide other nations with increased opportunity to export to us. We can, and should, do this in a way that avoids undue cost to any segment of our economy.

The other, and probably the greatest contribution we can make toward winning a reluctant world to our point of view, will be to offer ample and convincing evidence that we are ready and able to provide a high level of employment in the United States. If we can do that, the rest of the world will wish to expose itself to our influence rather than to insulate against it, since prosperity here is the greatest single contributing factor to world-wide prosperity.

Balance of payment problems are minimized in a world of thriving trade. Britain would have little reason to resort to exchange controls if the total of postwar world imports and exports reaches an 80 billion dollar level. She may well be in a desperate plight if it should revert to the 1935 level of 40 billions.

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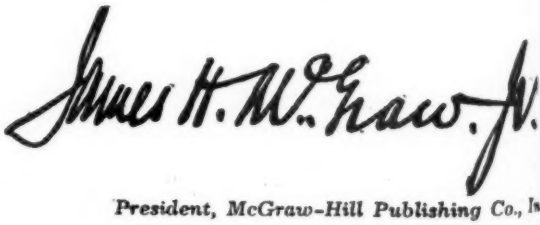
The United States wants a world in which private enterprise and competition play a major role. To obtain such a world will require a wiser, more understanding and firmer world leadership than this nation, or perhaps any nation, ever has exerted heretofore.



President, McGraw-Hill Publishing Co., Inc.

THIS IS THE 33RD OF A SERIES

Velox Boiler Development Continues

Range extended by construction of 300,000-lb-per-hr 1850-psi 925-F unit; progress in smaller units marked by simplification of evaporators, wall linings and preheaters*

▶ INVESTIGATION and development work have led to extension of the range of Velox boilers for land plants, including a 300,000-lb-hr 1850-psi 925-F unit, which resembles marine design in many respects. Attention was also given to continued improvement of smaller Velox plants for evaporation rates from 30,000 to 200,000 lb per hr, pressures from 200 to 700 psi and temperatures up to 925 F, with particular respect to simplification of evaporator elements, wall linings and preheaters.

The drawing below shows the layout and principal dimensions of the 300,000-lb-per-hr unit, fired by low-grade gas. With oil or high-grade gas as fuel, the evaporation rate would be 360,000 lb per hr. This unit includes a resuperheater for raising steam temperature to 800 F after expansion. The boiler consists of two casings, one containing the combustion chamber and the other the superheater. The main evaporator tubes are arranged horizontally in the lower part of the casings and in the section below them. Walls of combustion chamber and superheater are also formed by evaporators.

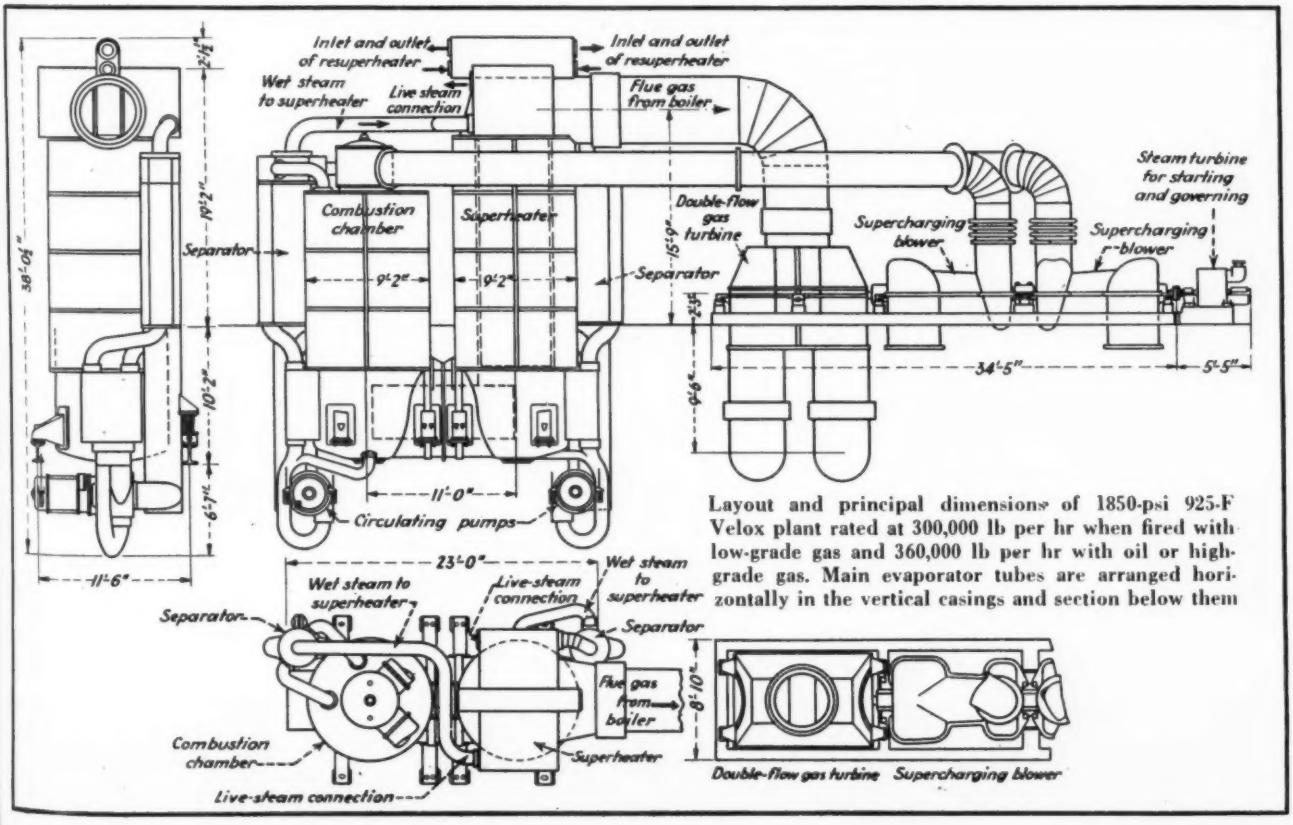
Two separators and two circulating pumps serve the unit. A double-flow gas turbine driving two supercharging blowers and a steam turbine for starting and governing complete the boiler plant, which is approximately 12 ft wide and fits conveniently between the steam turbines, which are both wider and longer.

The salient feature of the marine-type Velox, which this unit resembles, is the design of the evaporator elements. These are single tubes heated exclusively by the flue gas on the outside and inclosed in a special casing. This permits dealing readily with large quantities of flue gas and meets the requirement that no evaporator tubes in contact with hot gas shall have a wall thickness of more than 8 mm (0.312 in.). Even where the very highest pressures are concerned all heating surfaces take the form of readily interchangeable elements or nests of tubes.

Velox boilers with evaporation rates as high as 200,000 to 400,000 lb per hr are relatively small and can be erected either alongside or at least in the same room as the turbine. An idea of size can be obtained from the fact that for an evaporation of 2200 lb per hr the combustion-chamber volume is about 3.5 cu ft, evaporator surface is about 22 sq ft and internal cross-section of flues is about 7.5 sq in. Should resuperheating prove necessary, and the resuperheater be embodied in the boiler, erection of the entire boiler plant close to the turbine proves of particular advantage.

Good progress has been made with tests on pulverized-coal firing but details will not be published until such boilers are ready for the market.

* Abstracted from Brown Boveri Review, Vol XXXI, No. 1—2.



Layout and principal dimensions of 1850-psi 925-F Velox plant rated at 300,000 lb per hr when fired with low-grade gas and 360,000 lb per hr with oil or high-grade gas. Main evaporator tubes are arranged horizontally in the vertical casings and section below them

Plan Ahead for Modern Auxiliary-Drive Power Supply

Conference of manufacturers and users of electric station auxiliaries at AIEE meeting reviews latest trends in central-station equipment and layout for reliable power supply

► RELIABLE MODERN MOTORS, hydraulic couplings, air circuit breakers and metalclad switchgear have combined to afford engineers safe, economical and easy-to-maintain auxiliary drive systems, according to a group of experts participating in an open discussion of power supply problems before the American Institute of Electrical Engineers. With a few exceptions in some topping installations and other special cases, reported J B McClure of General Electric, motor-driven auxiliaries are used almost exclusively in large steam-electric stations.

H N Mueller, Jr, of Westinghouse, joined Mr McClure in a plea that design engineers give proper attention to the auxiliary-drive power-supply problem in early stages when future plants are being considered so that lessons learned in recent years can be incorporated in the over-all planning. Some of the suggestions include (1) individual power supply for each boiler (2) power supply from main generator terminals (3) preferred system voltages at 460 and 2400 v.

It is generally economical, stated Mr McClure, to use 460 v for transformer capacities up to 1000 kva, Fig. 1, while dual-voltage systems, Fig. 2, should be considered for transformer capacities of 1500 kva and upwards. Since two thirds to three quarters of the total auxiliary power is used by large individual motors associated with the boilers, such as pumps and fans, capacity of transformers and switchgear should be proportioned to individual boiler size rather than turbine ratings, particularly if two boiler units require individual supply sources, as in Fig. 3.

In planning, one should consider that (1) a source of power must be available for starting (2) the entire auxiliary supply system should be considered essential (3) where two voltages are used, it simplifies operation to bring all power through the higher voltage bus. The reliability of metalclad insulated 5-kv buses and metal-inclosed 600-v buses justifies a single bus system. Transformers are sufficiently reliable for satisfactory radial systems.

In summarizing motor practice for power station auxiliaries, Hal Gibson, of General Electric, noted that some new plants are using synchronous motors with variable-speed couplings instead of the more common induction machines. However, the added cost and complication can seldom be justified. Direct-current drive in large modern stations, he said, is at present practically extinct.

In reporting users' experience, W R Brownlee, of Jackson, Mich., described a series of experiments on a pulverized-fuel boiler, checking the possibility of flame extinguishment by external voltage disturbances. With ball-mill pulverizers operating at maximum output, power supply to an entire group of boiler auxiliaries was intentionally interrupted for varying periods of time from 18 cycles to 6 seconds.

For relatively short interruptions there was no observable difference in flame performance and speed changes

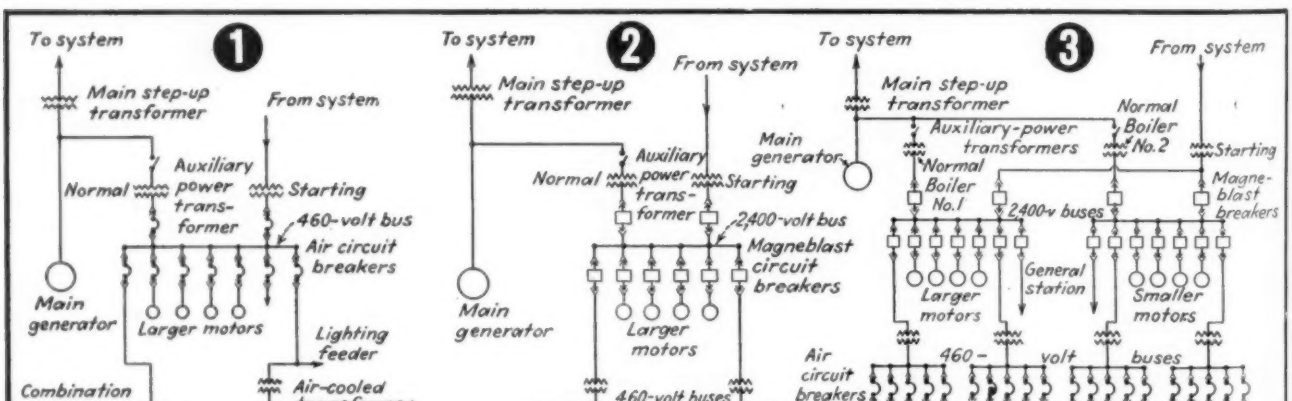


Fig. 1—Schematic layout for 480-v system for one or two boilers with individual feeder positions for larger motors. Power comes normally from main generator terminals, other starting supply presumed available. Fig. 2—Larger installation justifies 2400-v and 480-v bus arrangement with two intermediate transformers. Fig. 3—Supply for two large boilers is assured by dividing power circuits to prevent outages on one of the boiler systems from involving that of the other

were imperceptible. For longer interruptions fans and exhausters slowed down considerably and the pulverizer actually stopped after about four seconds without extinguishing the flame. Coal carried in suspension provided the necessary carryover and restarting of pulverizer was rapid.

Mr Brownlee's experience has demonstrated the reliability and economy of a station power system supplied from transformers rather than from house turbines or shaft generators. Connecting house transformers at generator voltage, he added, provides a natural cushion against transmission system faults. Line-starting squirrel-cage induction motors are used for practically all drives.

Auxiliary power plans for Philadelphia Electric's new Southwark station were detailed by J H Harlow. The first 150,000-kw unit with two 850,000-lb-per-hr boilers will have to operate isolated for some time before a second similar installation can be made at the same site. To guard against loss of auxiliaries on an entire boiler, power supply has been divided so that one bus supplies half the auxiliaries of each boiler, the remainder having an alternate source.

A house turbine set supplies two 4000-v bus sections and is supported by transformers connected to the station 13.2-kv bus. To enable self-starting from cold, installation of a small diesel-engine-driven generator is being considered. It will have sufficient capacity to drive fans slowly through temporary belt drives, and necessary oil and water pumps for getting up steam to drive the auxiliary generator.

Proposed Standards for Turbine-Generators

3600-Rpm 3-Phase 60-Cycle Condensing-Type Turbine-Generators

		Air-cooled generator		*Hydrogen-cooled generator Rated for 0.5 psig hydrogen pressure*			
Turbine rating, kw		11,500	15,000	20,000	30,000	40,000	60,000
Turbine capability, kw		12,650	16,500	22,000	33,000	44,000	66,000
Generator rating, kva		13,529	17,647	23,529	35,294	47,058	70,588
power factor		0.85	0.85	0.85	0.85	0.85	0.85
short circuit ratio		0.8	0.8	0.8	0.8	0.8	0.8
Throttle pressure, psig		600	600	850	850	850–1250	850–1250
Throttle temperature, F		825	825	900	900	900–950	900–950
Number of extraction openings		4	4	4	5	5	5
Saturation temperature	1st	175	175	175	175	175	175
at opening	2nd	235	235	235	235	235	235
at	3rd	285	285	285	285	285	285
turbine	4th	350	350	350	350	350	350
rating, F	5th	———	———	———	410	410	110
Exhaust pressure, in. Hg		1.5	1.5	1.5	1.5	1.5	1.5

	Hydrogen-cooled generator— Operated at 15 psig hydrogen pressure			
Generator capability at 0.85 power factor, kva	27,058	40,588	54,117	81,176

(1) A tolerance of plus or minus 10 F shall apply to above saturation temperatures. (Tolerances shall be unilateral so as not to reduce the spread in temperature between adjacent extraction openings.)

(2) The turbine capability is guaranteed continuous output at generator terminals when the turbine is clean and operating under normal steam conditions with full extraction from all openings.

▶PREFERRED STANDARD RATINGS for 3600-rpm 3-phase 60-cycle condensing turbine generators prepared by a joint committee of ASME and AIEE have been offered to manufacturers and users for one year's trial. These standards are not intended to preclude manufacture of special machines where needed but are expected to result in quicker deliveries and probably lower costs for standard units.

Six standard sizes are proposed between 11,500-kw and 60,000-kw, as shown in the table. Steam pressures most suitable for these machine sizes have been set as well as a definite number of extraction openings for feedwater heating with specified values of saturation temperature at each opening. Turbines built according to the new standard are to be capable of 10% above nameplate rating and generators are to be rated normally at 0.85 pf. This will provide greater generator capacity in proportion to the turbine than in present usual ratings.

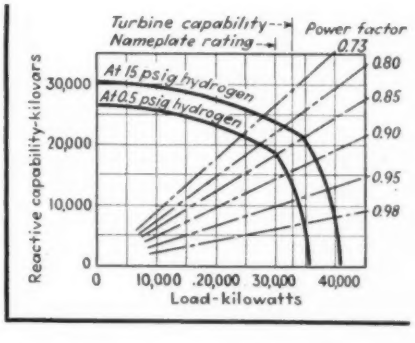


Chart of load kilowatts, reactive capability and power factor for 30,000-kw, 0.85-pf hydrogen-cooled machine with turbine capability of 33,000 kw at 0.5-psi and 15-psi hydrogen pressures. Similar curves for each of the standard sizes indicate limits of performance

Four values for generator voltage have been provided for, along with other electrical details in supplementary specification data. Many of the requirements are already codified by American Standards Association in ASA C50 for Rotating Electrical Machinery, but certain new or different provisions have been included. Comments will be welcomed by the Committee during the trial period of one year before the Standards have permanent status.

Hydraulic System Starts Emergency Diesel Automatically

Using engine lubricating oil as actuating medium, controls bring 220-hp air-starting unit up to load within one minute after factory power supply fails

▶AN INTERESTING hydraulic control system features a diesel emergency-power installation recently reported in the *Oil Engine* (London). This system automatically sets in motion a 220-hp air-starting diesel when the outside electricity supply goes dead.

The engine, a standard 4-cyl 10x12-in. 660-rpm English Electric unit, is installed in a large factory normally supplied with electricity from the British grid system. The engine drives a 150-kw ac generator, which provides current for the emergency lighting systems in the factory, air-raid shelters, surgeries, first-aid rooms and fire stations and for shelter ventilating fans, fire alarms and telephones. English Electric Co automatic switchgear completes the installation.

The diagram below shows the automatic engine-starting system. Starting air is supplied by a compressor driven by a spark-ignition engine; working pressure is 350 psi. Two of the four engine cylinders receive starting air. The oil used as an actuating medium for the hydraulic system comes from a high-level tank, kept filled by a float-controlled motor-driven pump taking suction from the engine's underfloor oil sump tank.

The outlet from the high-level tank contains a solenoid valve energized from the incoming feeder. As long as the feeder is alive, the valve remains closed. If current fails, the deenergized valve opens, allowing oil to flow from the tank, under an appreciable head, through the control valve to the engine system. This floods the bearings ready for starting and builds up pressure in the circuit. The servo-piston rises and, through a linkage, operates the pilot air valve, which opens and allows air from the receiver to enter the engine's automatic starting valve. Air then reaches the starting valves on the two cylinders so fitted and the engine starts in the usual way.

Once the engine is rolling, oil pressure from the engine's own pump soon builds up and lifts the weighted valve which drains oil from below the servo-piston. It falls into its cylinder, closing, in turn, the pilot air valve and the engine's automatic starting valve. This cuts off air.

Following standard English Electric practice, the engine carries a hand control for speed, which is used only for ordinary manual purposes. An oil-operated speed check limits the fuel under automatic starting conditions so that when firing begins the engine does not at once race up to its governed speed. The engine can also be set in motion by a hand air-starting valve.

When power supply returns, the switchgear automatically unloads the engine, which runs until shut down by hand. The operator then bars the flywheel to the starting position ready for the next run. Strainers in all air lines safeguard the automatic valves.

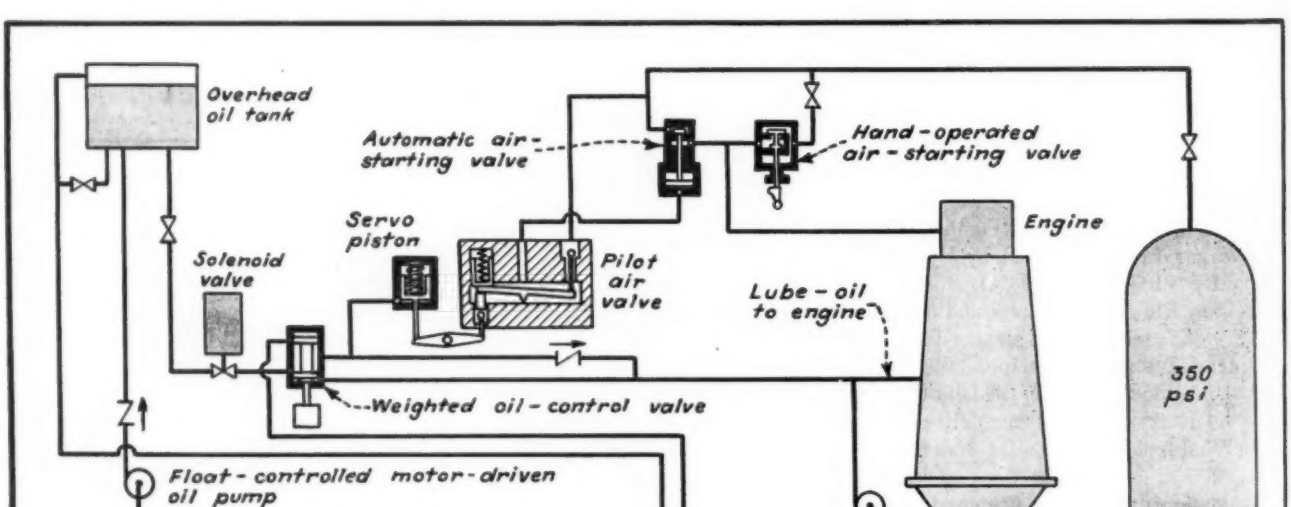


Diagram shows high-level oil tank, solenoid valve energized from feeder, hydraulic-control and air-starting valves

THE OPERATING ENGINEER

George Edwards *Advisory Editor*

PRACTICAL AIDS · MAINTENANCE HINTS · QUESTIONS — ANSWERS

PUBLISHED MONTHLY AS AN INTEGRAL PART OF POWER

Charcoal Takes Color Out Of Boiler-Water Test Samples

Urban C Fleming, Jr, chemist for Holyoke, Mass., Gas & Electric Dept, tells how activated charcoal removes dark brown color of boiler-water sample caused by tannin feed so that accurate analyses are possible. Also reports on check tests

MORE AND MORE operating engineers are coming to realize that the only way to get real control of boiler-water conditions is to make daily tests for alkalinity, chlorides and phosphates. In connection with this daily testing procedure, we have recently overcome a problem that may have baffled others also.

We find it necessary to feed about three pounds of tannin a day to the boiler-feed suction to minimize deposit of scale in the economizer tubes of a Riley boiler operating at 475-psi drum pressure. We also feed about a pound a day of sodium metaphosphate with the tannin. The phosphate serves to prevent hardness in the water from settling out, but near the top row of economizer tubes the water temperature becomes high enough to break down the metaphosphate to trisodium orthophosphate, which combines with hardness in the water to form calcium-phosphate sludge.

While the tannin serves its purpose admirably in preventing deposits of sludge in the economizer tubes, it imparts a deep brown color to the boiler water. Anyone familiar with the routine color-comparator tests will realize how much this coloring effect interferes with obtaining proper end-points in the analyses. We have overcome the difficulty by decolorizing the samples with activated charcoal.

Fig. 1—Colored boiler-water sample containing tannin is changed to crystal clear filtrate after shaking with activated charcoal and 15-min rest

The usual boiler-water sample, taken in a one-quart mason jar, shows a deep brown color. We add a teaspoonful of activated charcoal (decolorizing carbon) to the water sample in the mason jar, replace the cover and allow the sample to stand 15 min after vigorous shaking to insure good mixing.

After the period of standing, the sample is filtered through a No. 5 Whatman filter paper into a clean, dry glass jar or beaker. The filtered sample comes through crystal clear.

However, to be sure that addition of activated charcoal introduced no error in the determination of alkalinity, chloride or phosphate concentrations in the boiler water, certain check tests have been carried out. We took duplicate samples of water from four other 200-psi boilers not treated with tannin and which, therefore, had no brown color characteristic.

For each of the tests, one set of samples was merely filtered before reagents were added. These are designated *A* while another set of samples to which activated charcoal was added are denoted *B*. For each *B* sample, one teaspoonful of activated charcoal was added, the sample shaken and allowed to stand 15 min with the cover on to minimize exposure to air, which tends to decrease hydroxide alkalinity. After standing, each *B* sample was filtered through No. 5 Whatman paper into a clean, dry glass jar. The clear filtrate was then tested and results listed in Table I.

From an inspection of the tabulated

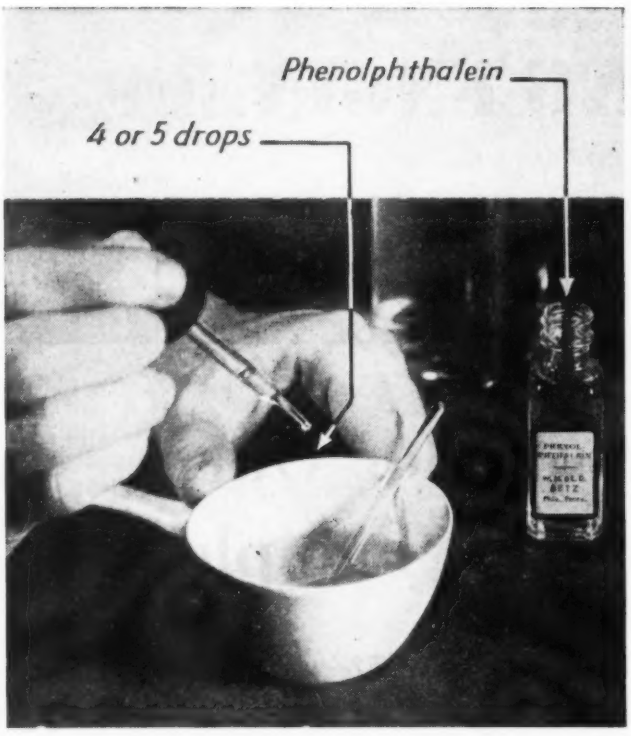


Fig. 2—Phenolphthalein indicator is an essential part of alkalinity test. Endpoint is indefinite and unsatisfactory if tannin or other material discolors the sample

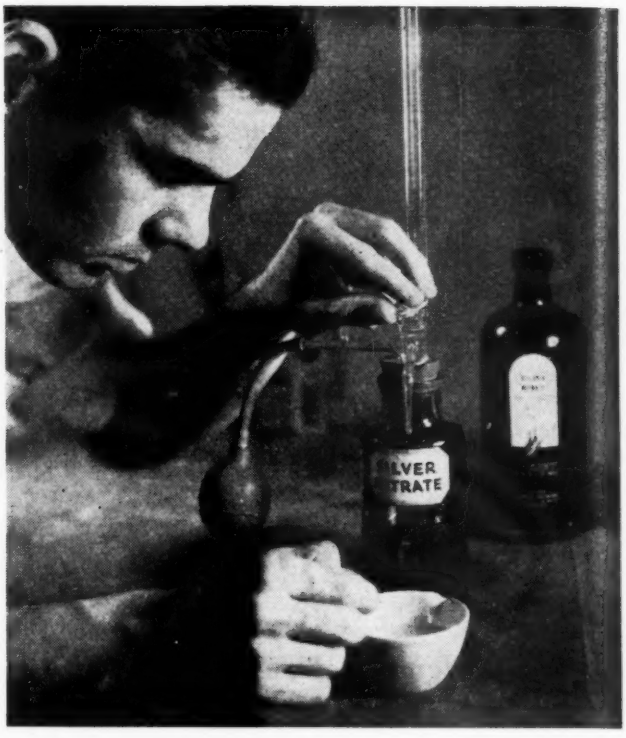


Fig. 3—Silver-nitrate solution should be added to the sample slowly while stirring for the chloride test. Charcoal absorption of color does not greatly change results

results of the duplicate samples it is apparent that the greatest error occurs in the hydroxide alkalinity test, on a sample from Boiler No. 1 which required 0.8 cc less acid for neutralizing the activated-charcoal-treated sample than the corresponding untreated water. The percentage of error is seen to be $0.8 \div 11.3 = 0.07$, or 7%. Even this is much less than the expected error that would obtain if an attempt were made to determine alkalinity of an undecolorized sample, for which it is almost impossible to distinguished the phenolphthalein endpoint. Also, for routine check tests a variation in alkalinity up to 10% does not appreciably affect the interpretation of the tests.

Method Satisfactory

For the chloride and phosphate tests it is obvious that results are closely in accord. We have concluded that decolorizing carbon or activated charcoal affords a satisfactory means of eliminating interference caused by highly colored constituents of boiler water and that routine tests can be carried out in this manner without serious error.

Experience indicates that 15 min is sufficient standing period to accomplish practically complete absorption of the organic coloring matter by the charcoal. The same procedure applies for removing fine particles of phosphate sludge from boiler water where simple filtering is inadequate. The charcoal aids in trapping the fine particles so that no error is introduced in the phosphate

TABLE I—COMPARISON OF DUPLICATE SAMPLES

Boiler No.	Hydroxide Alkalinity Test				Chloride Test				Phosphate Test	
	Sample A — Filtered boiler water		Sample B — With activated charcoal		Sample A — Filtered boiler water		Sample B — With activated charcoal		Sample A — Filtered boiler water	Sample B — With activated charcoal
	Cc N/50 sulphuric acid	*Ppm hydroxide*	*Cc N/50 sulphuric acid*	*Ppm hydroxide*	*Cc silver-nitrate solution**	*Ppm chloride*	*Cc silver-nitrate solution**	*Ppm chloride*	*Ppm*	*Ppm*
1	12.1	82.3	11.3	76.8	4.85	48.5	4.82	48.2	100	100
2	17.3	117.6	16.5	112.2	5.80	58.0	5.75	57.5	50	50
3	15.3	104.0	14.6	99.3	9.90	99.0	9.80	98.0	40	40
4	12.5	85.0	12.0	81.6	6.80	68.0	6.70	67.0	55	55

* *Blank value of 0.3cc subtracted*

determination through presence of insoluble calcium phosphate in the filtered sample.

Tests reported here are standard determinations such as may be found in any text on boiler-water analysis. However, for those not familiar with the procedure or others who might wish to check the results, these tests are briefly outlined.

For the hydroxide alkalinity test, measure a 50-cc sample of filtered boiler water in a graduated cylinder and pour into a 150-cc casserole. Then add 5 cc of barium chloride (10%) and stir the sample vigorously with a glass rod. Add phenolphthalein indicator (5 drops), Fig. 2, and then feed sulphuric acid (N/50) slowly from a burette until the last drop causes a color change from pink to colorless. The number of cc added measure hydroxide alkalinity. Multiplying cc of N/50 sulphuric acid by 6.8 gives alkalinity in parts per million.

Testing for Chlorides

For the chloride test, a 50-cc sample of filtered boiler water is measured out in a graduated cylinder and poured into a clean 150-cc casserole as in the alkalinity test. After adding phenolphthalein indicator the sample is neutralized with N/50 sulphuric acid as before. Then one cc of potassium chromate indicator is added to the solution in the casserole. From a burette add silver-nitrate solution (1 cc = 0.005 grams chlorine equivalent) until color of solution changes from yellow to reddish brown. Record number of cc of silver-nitrate solution.

A "blank" determination must be carried out with procedure similar to that just described but using a 50-cc sample of distilled water. The amount of silver-nitrate solution required to give the reddish brown color in chloride-free water (distilled water) is generally about 0.3 cc. This amount is subtracted from the number of cc used in the boiler-water sample to give the net amount required to react with the chlorides in the boiler water. Net cc of silver-nitrate solution multipled by 10 gives chloride concentration of boiler-water sample in parts per million.

For the phosphate test we use a Taylor high-phosphate comparator. Phosphate concentration is read directly in parts per million, as shown in the table, by comparison of color intensity with fixed standards.

Up the Hill and Down Again

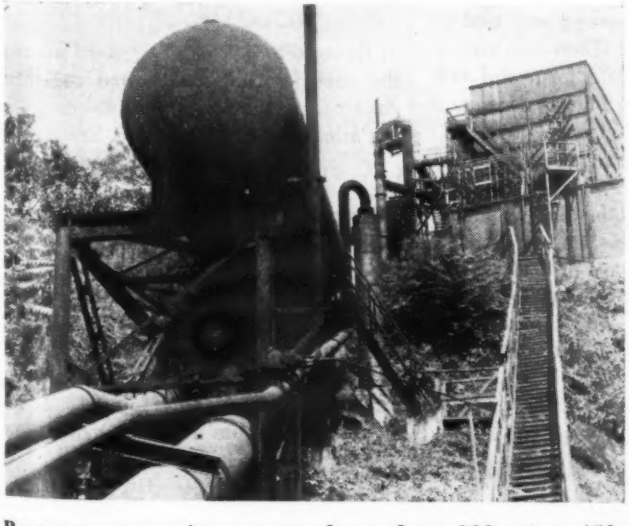
IN MAKING AMMONIA by high-pressure synthesis, large amounts of CO_2 must be removed from the gas by scrubbing at high pressure with water. A steep 800-ft hill near the Belle plant of E I du Pont de Nemours affords a means of saving about two thirds of the pumping power otherwise needed.

The purification process uses 35,000 gpm at 400 psi in large pressure scrubbers. Normally a Pelton wheel would be installed in the scrubber discharge to recover as much pumping power as possible, something less than 40%. With the hill nearby, however, water can be taken under its own pressure up to an aeration tower for degasifying and returned by gravity to the pumps which merely supply pressure losses in piping and process.

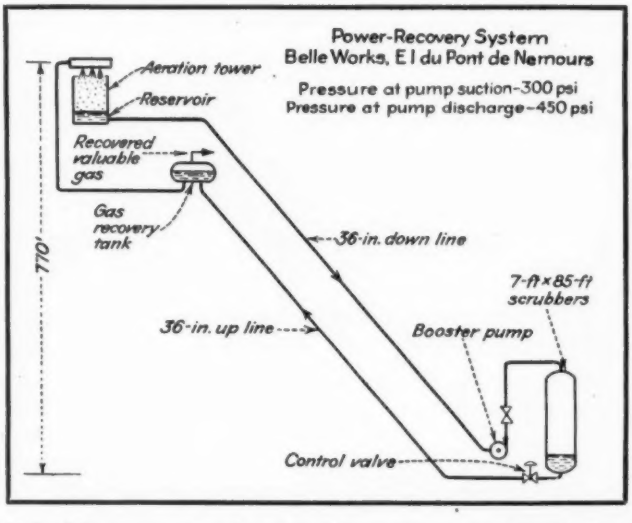
Water passes from the base of the scrubbers through a control valve adjusted to maintain a constant water level in the scrubber. A reservoir at the top of the hill is high enough to require about 320 psi at the base of the 36-in. "up" line to deliver water to the top of the aeration tower. Thus the pumps supply only one third of total pressure.

In the tower dissolved gases are removed by counter-current air flow. Water collected returns to the booster pumps. This system has operated several years with a minimum of trouble. Access to the hilltop area is provided by an electrically operated hoist.

Another advantage of the system lies in the ability to recover valuable gases dissolved in the water along with the impurities. As water rises in the pipeline up the hill, pressure decreases. Since the *valuable* gases are less soluble than the *impurities* the value elements are released first as pressure diminishes. Suitable separators on the up line at proper pressure levels recover these by-products for return to the plant and further use. The aeration tower removes impurities from the water and also dissipates heat added to the water by the pumps.



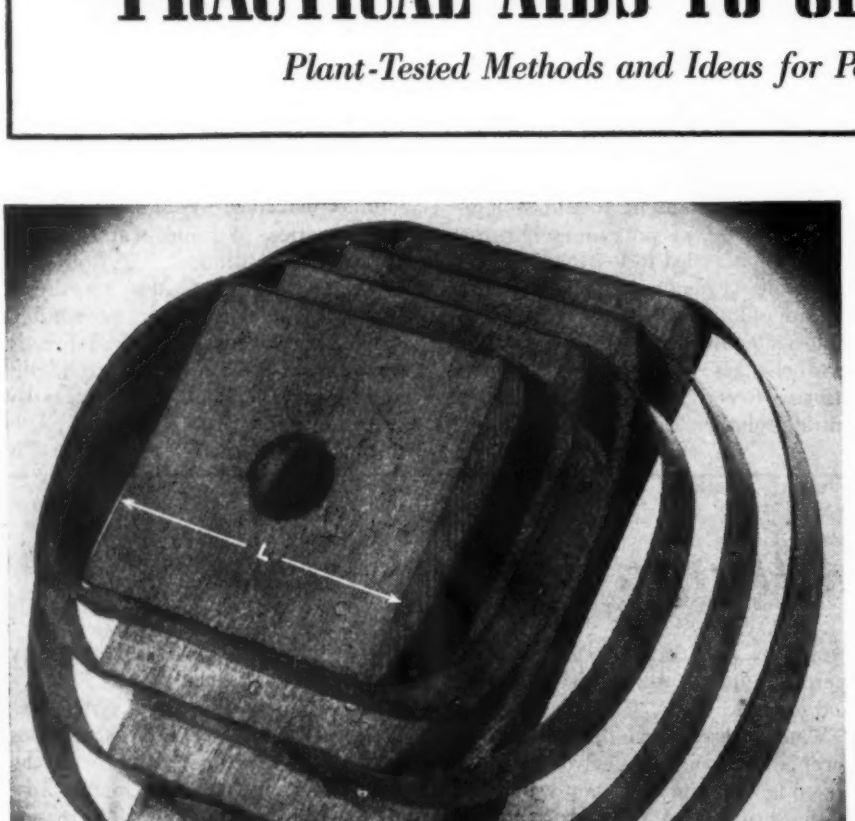
Booster pumps raise pressure from about 300 psi to 450 psi, supplying only one-third pressure needed by process



Valuable gases absorbed in the water are released first and collected by separators in "up" line ahead of tower

PRACTICAL AIDS TO OPERATION

Plant-Tested Methods and Ideas for Power Men



COIL FORM HELPS REWIND SMALL MOTORS

MANY FORMS have been designed on which to wind armature and stator coils, but the one that I use is simple to construct and serves to wind mush coils for small motors. As shown in the photo, it consists of pieces of wood $\frac{5}{8}$ in. thick and of different lengths nailed together. The coil formers are strips of thin fiber tacked to the wood.

Length *L* is made equal to the motor core width and the other dimension equal to the coil span in the core slots. Fiber strips have to give coils sufficient length so they will not bind at the ends when they are put in the slots. These strips can be easily adjusted for length if a coil is a little too long or short.

A hole in the form center permits securing it on a bolt held in a vise while the coils are being wound. The form is provided with a lift for each size coil in a pole-phase group. All coils in a group are wound as one continuous coil without a break between their ends.

Beginning on the form's center section the first coil is wound and tied at the ends to the fiber. Then the wire is taken out to the second form and this coil wound and tied. This is continued until all coils in a group are wound.

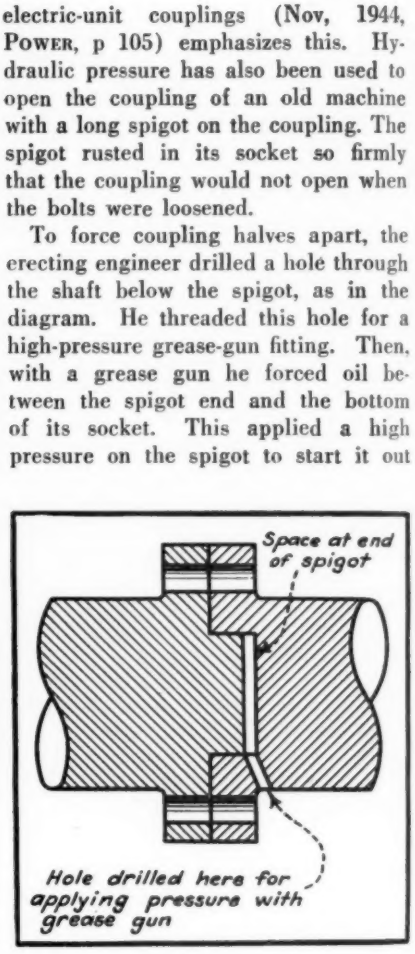
When the coils are removed from the form they fall within one another and can be easily placed inside the motor core and fed into the slots one wire at a time. These forms are probably a little too frail for heavy use, but for an occasional rewind job they are okay.

Englewood, N. J. R BOETTINGER

Hydraulic Pressure Opens Frozen Couplings

NECESSITY is the mother of invention and Richard Deane's hydraulic jack method of closing vertical-shaft hydroelectric-unit couplings (Nov, 1944, POWER, p 105) emphasizes this. Hydraulic pressure has also been used to open the coupling of an old machine with a long spigot on the coupling. The spigot rusted in its socket so firmly that the coupling would not open when the bolts were loosened.

To force coupling halves apart, the erecting engineer drilled a hole through the shaft below the spigot, as in the diagram. He threaded this hole for a high-pressure grease-gun fitting. Then, with a grease gun he forced oil between the spigot end and the bottom of its socket. This applied a high pressure on the spigot to start it out of its socket, and also forced oil around the surfaces that had rusted together. As a result, the coupling opened.



Philadelphia, Pa. R O SPENCER

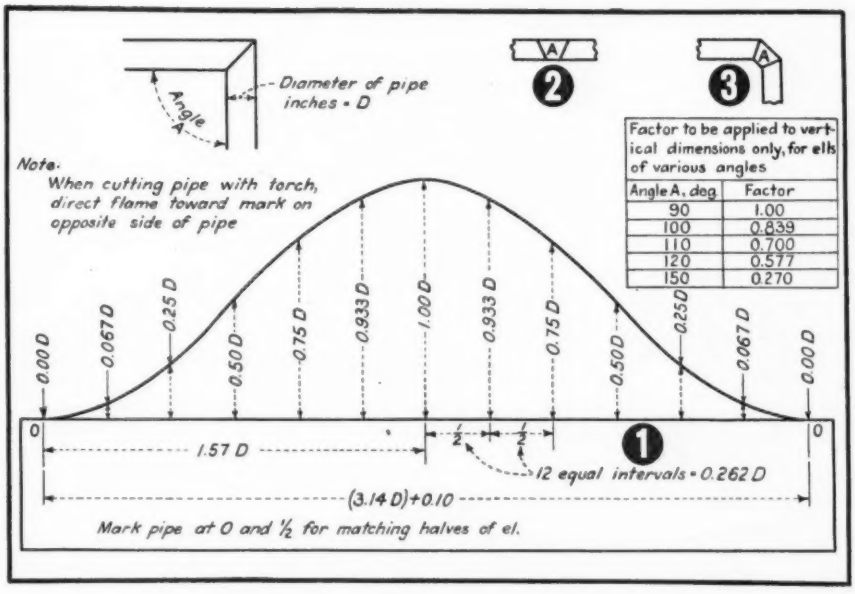
Simple Template Insures Correct Pipe Cutting

WE NEEDED TEMPLATES for laying out pipe ells and used the method in the diagrams, which can be applied to ells of any size and for different angles, either single or double jointed. It requires a minimum of drafting with few instruments such as a straight edge, rule and square, generally available in any shop.

To obtain dimensions of a template for a 90-deg single-jointed ell multiply

values on the diagram, Fig. 1, by the outside diameter of the pipe. For example, assume an outside pipe diameter of 6.625 in. Then the template base is $3.14\times6.625+0.10=20.9$ in. long. This dimension is divided into twelve equal parts, each of which is $0.262\times6.625=1.74$ in. long. Center dimension of the template will be 6.625 in., those next to the center $0.933\times6.625=6.18$ in., and so on down to the end. After calculating dimensions, lay out the template as shown. Dimensions of templates for ells having angles other than 90 deg are obtained by multiplying the dimensions of a 90-deg template by the values in the table. Assume a pipe outside diameter of 6.625 in. as before and an ell angle of 110 deg. Then the template center dimensions would be $6.625\times0.7=4.65$ in. and the first dimensions on either side of the center $6.18\times0.7=4.34$ in. and so on for the other dimensions.

Vertical dimensions for a 90-deg 2-jointed-ell template may be obtained by first calculating the dimensions for a single 90-deg joint and then multiplying the values by 0.414.

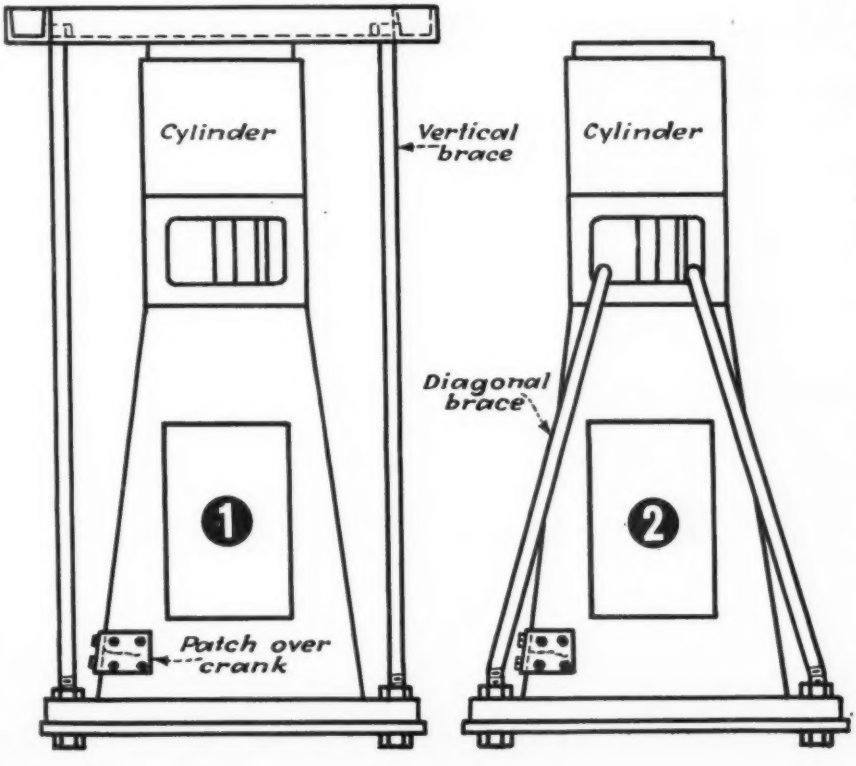


After template dimensions are figured, lay out the pattern on heavy paper and draw a smooth curve through the points. Now cut the template along its outline and wrap around the pipe to mark the line along which to cut. Double-jointed ells are marked off on straight pipe using the template, as in Fig. 2. Section *A* can be cut any length, depending on requirements and the three parts assembled as in Fig. 3.

Dixon, Ill. LOUIS T SAMPSON

BRACING STRENGTHENS STEAM ENGINE FRAME

WHEN I TOOK CHARGE of a plant's operation the crankcase of a small blowing engine had been cracked and patched. To give the case added strength it was braced, as in Fig. 1. A piece of channel iron placed diagonally across the cylinder head was tied down by two long bolts through the engine base and floor.



The brace was awkward to have around the engine and did not give the support that its designer intended. To correct this I made four braces, as in Fig. 2. These hook on the frame below the cylinder, and their threaded ends were bent to go vertically through the base and floor holes. After the bottom nuts were tightened to pull the engine down firmly on the floor, the top nuts were pulled down to lock the engine base in place. The angle at which the new rods pull gives the engine much more stability than the vertical arrangement.

Great Neck, N. Y. S M ELONKA

Methods of Cleaning Motor Windings

AMONG MAINTENANCE MEN there is considerable difference of opinion on the best method of cleaning motor windings. Practice varies with the kind of cleaning job. Unless a winding is badly oil soaked there is probably little reason for soaking it in cleaning fluid.

It has been my practice to try to remove as much dirt as possible before applying cleaning fluid. This is done with coarse hair brushes of different

sizes. When I have loosened and removed all the dirt I can in this way I use a vacuum nozzle to pick up any loose dirt I missed. In ventilating ducts and other places where vacuum may not be effective I use 40-psi compressed air.

After the windings have been carefully cleaned by this means I do a final cleaning job by wiping with light-weight rags dipped in gasoline. Be sure to clean the coils carefully where they come out of the slots. It is here that the insulation is most likely to crack and unless these parts of the windings are well cleaned and varnished, conducting dirt may work through the insulation and cause a failure. In plants where conducting ducts are present, the point where the winding comes out of the slots is one of the commonest sources of trouble.

If you remove most of the dirt from the winding, you do not have to apply nearly so much cleaning fluid to do a good job. When you use cleaning fluid on a winding to remove dirt the two form a solution that works into insulation cracks. The more dirt the solution carries the more will be deposited in the cracks when the solution evaporates. If the winding is well cleaned before applying the cleaning fluid, the solution is fairly clean when it reaches the insulation cracks and is more likely to clean them out than when the solution is saturated with dirt.

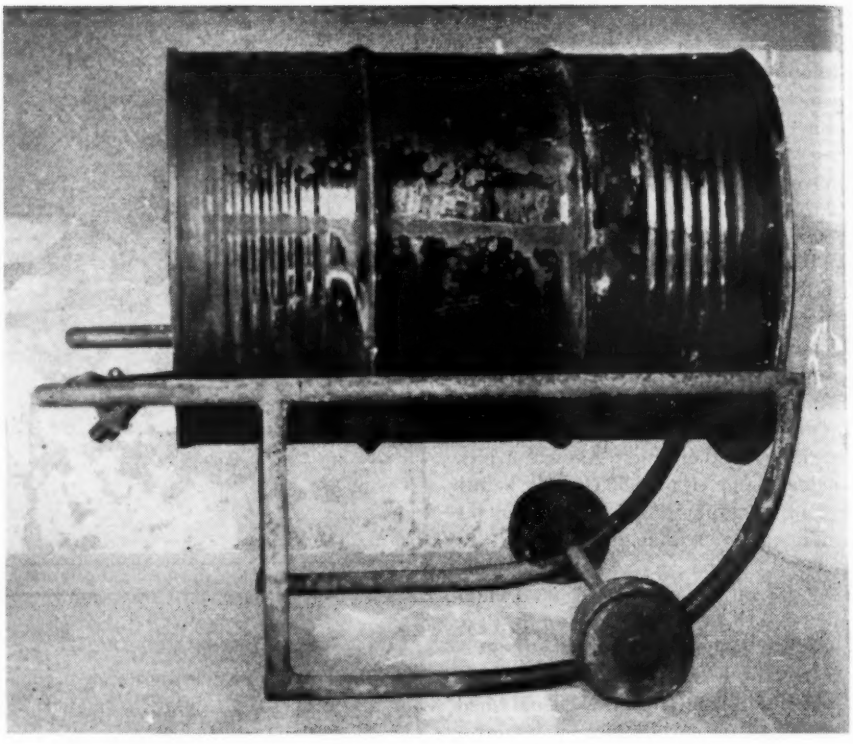
Cleaning Gummed-up Windings

When windings are gummed up with grease and dirt, scrape off as much of the mixture as possible before applying the cleaning solution. A common paint brush is excellent for the job. It mixes the fluid with the dirt and the two run off without subjecting the insulation to a scrubbing action. After removing practically all dirt from the winding in this way, wipe it clean with light-weight rags dipped into cleaning fluid.

Gasoline makes as good a cleaning fluid, but is a fire and explosion hazard. Carbon tetrachloride is used widely, but must be applied with care or it may prove harmful to insulation.

When using either of these for cleaning windings, if the insulation is carefully cleaned and wiped dry there is generally no need for baking the machine unless the insulation resistance tests low. If the machine is not baked, let it remain about two hours after cleaning before applying the varnish coat. This, in general, is the practice we follow in cleaning our motors and it has been highly successful.

Chicago, Ill. J B MULLINS



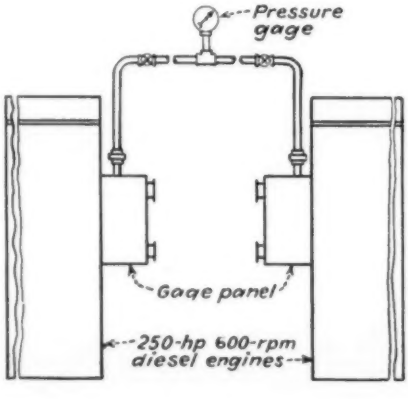
COMBINATION OIL DRUM RACK AND TRUCK

REQUIRING SOME MEANS of handling large drums of lubricating oil from drum storage when filling gas-engine and compressor crankcases, the plant engineer designed and built a combination drum rack and truck (see photo) from material in the plant junk pile, put together with a welding torch. Frame, handles and cradle for the oil drum are made of small diameter pipe and the wheels are formed from circular steel plates with tires made of narrow bands from 6-in. pipe. The axle is a short piece of ordinary steel rod, which supports the load on pipe-nipple bearings in the wheels. It is welded to the truck frame.

Santa Monica, Calif. J C ALBRIGHT

One Pressure Gage Serves Two Engines

ON A DIESEL-ENGINE-DRIVEN BOAT the oil-pressure gage on one of the engines failed. We removed it and found that with the facilities available it was broken beyond repair. As we would not reach port for several days something had to be done to read oil pressure on both engines on the one available gage.

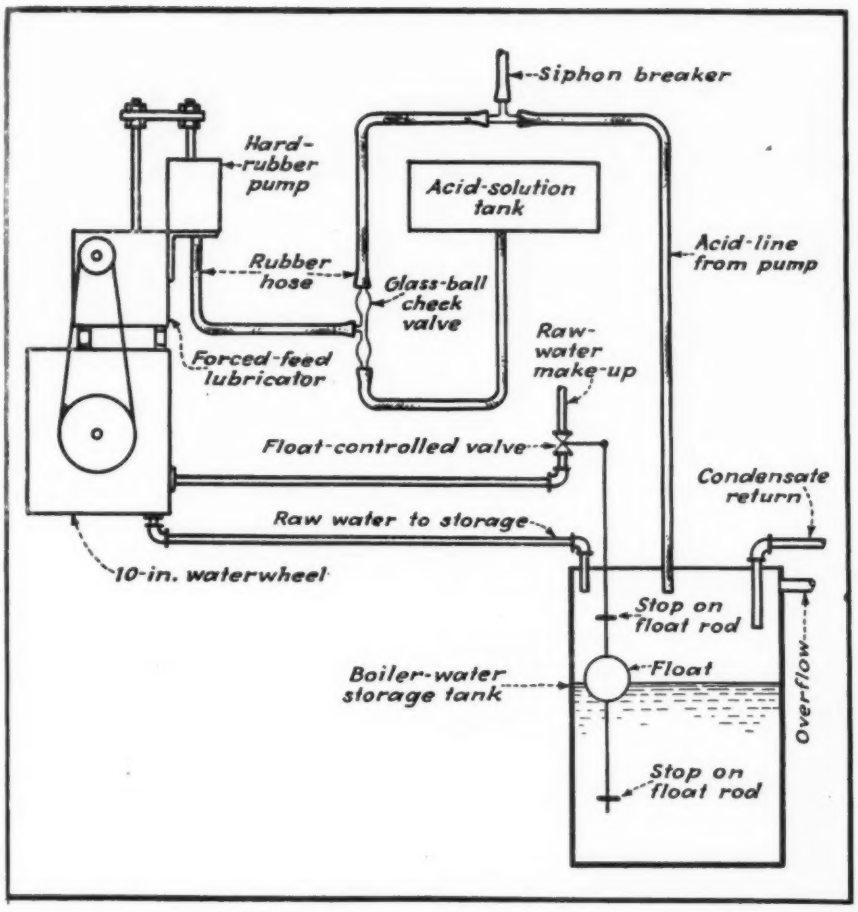


We had some ¼-in. pipe and fittings on hand and with these connected the good gage to both engines, as in the diagram. A valve on either side of the gage allowed us to connect it to either engine at will. Other engineers might think up a better way of overcoming this trouble, but our makeshift permitted us to operate the engines safely for several days until we got back to port.

WILLIAM T MULLEN
Philadelphia, Pa.

Makes Automatic Acid Feeder for Feedwater

BOILER WATER in our plant is quite high in soluble salts, largely sodium, so we treat the water with a 50% sulphuric-acid solution to maintain the carbonate-sulphate ratio below the danger point. All available condensate is returned to



the boiler-water tank to which is added raw-water makeup, which drives the acid-pump turbine. Originally we used a chemical feeder, but it failed to stand the 50% sulphuric-acid solution, so we built the system in the diagram.

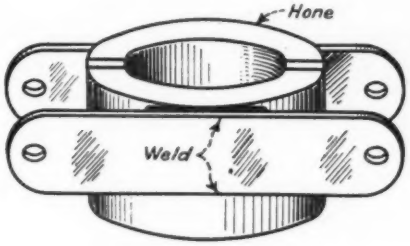
The 10-in. waterwheel is belted to a single-element forced-feed lubricator, the plunger of which connects to a Durimet piston rod of a single-acting hard-rubber pump. A section of rubber hose connects the pump cylinder to a glass tee and two glass-ball check valves. These valves form the suction and discharge valves for the pump. Suction valve connects to a lead-lined acid-solution tank and discharge valve connects to the feedwater storage tank. From the discharge line a length of hose extends vertically far enough to prevent acid overflowing and serves as a vacuum breaker. This prevents acid from siphoning from the lead-lined tank to the feedwater storage tank.

Operation of the system is controlled by a float in the feedwater storage tank. When the feedwater tank is full the float rises to where it closes the valve in the raw-water line and stops the waterwheel. As long as condensate is sufficient for boiler feed no acid is fed to the feedwater tank.

When the water level in the tanks drops down near the bottom the float opens the raw-water valve. This starts the waterwheel to feed raw water and acid to the storage tank until it again fills and stops the waterwheel, water and acid feed.

Each day oil that accumulates on top of the storage tank is floated off. In the equipment arrangement, the waterwheel and pump are located near the top of the storage tank in a compact assembly.

Los Angeles, Calif. G D Dub



Homemade Hone Cleans Shaft Journal

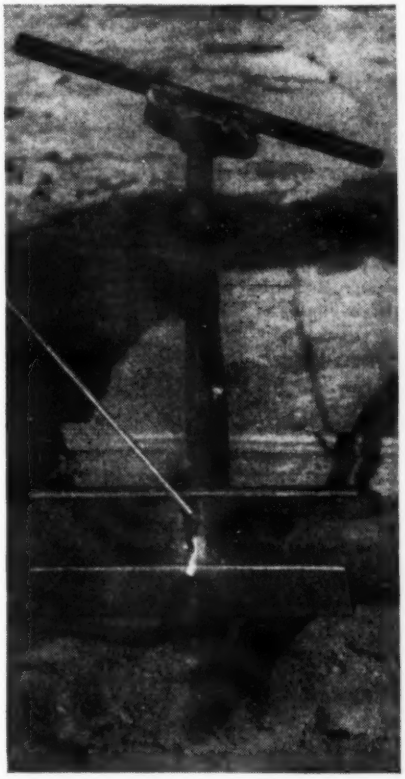
We had the job of cleaning a rough shaft journal without the proper equipment. Accordingly we made the outside grinding hone shown in the figure from a piece of round steel stock cut the same length as the journal and bore for a slightly larger diameter. After cutting the hone in two longitudinally, we clamped the halves between two pieces of flat steel and welded the clamp to the hone.

To do the grinding job we put grinding compound on the journal and clamped the hone on it. Then, turning the hone by hand on the journal and slowly feeding grinding compound into it we worked the journal down to a good surface.

Toronto, Ont. David A Burma

Angle-Iron Sections Improve Welding Clamps

Pipes that are not properly supported are difficult to align for welding. To insure proper alignment of the two



pipe ends, one company welded two sections of angle iron to the jaws of C-clamps, as in the photo. With these clamps, pipe ends up to 4-in. diameter can be brought in good alignment and held while trimming to fit and tack welding.

These clamps save many hours of labor during a year where many welds have to be made. A short length of pipe was welded to the top of the tightening screw to provide more leverage on the clamp.

Wichita, Kan. Harry A Hess

READER'S PROBLEMS

Exercise your engineering wits by submitting answers to these questions fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay

Questions from Our Readers

1—Does Our Plant Warrant Unit Drive?

WE ARE AT PRESENT driving our plant by steam power through line shafts belted to the machines. One, 60 ft long, is driven by an 18x18-in.-cyl 110-rpm 150-psi 270-hp steam engine. Another shaft running at right angles to the first, but not connected to it, is driven by a 20x20-in.-cyl 170-rpm 150-psi steam engine.

Machines connected to the first shaft are: two planers, a 6-in band saw (600 rpm), a blower, two trimmer saws and a transfer chain. Manufacturers specifications require a 70-hp electric motor for each planer, a 40-hp motor for the band saw, a 40-hp motor for the blower, and a 25-hp motor for transfer chain and trimmer saws combined.

The second shaft drives a 7-in. band saw (585 rpm) requiring a 50-hp motor, two 6-in. band saws that require a 40-hp motor each and one blower that requires 25 hp.

We are now considering moving the two 6-in. band saws in front of the planers so that lumber will travel directly from the saws to the planer table. This move means installing a right-angle drive for the saws and entails more expense in shafting pulleys and belts.

Present operating and maintenance cost in belting, greases, oils and lace leather is considerable. Foundations are not sound and we experience trouble with bearings coming out of line.

Is it advisable to convert all machines to electric drive or just equip the two 6-in. saws with electric motors, buy power, and leave the planers with their present drive? Is one engine large enough to motorize the plant so that we can discard the second? How much generating capacity will we need? Should we use dc or ac and at what voltage? Also what type of motors should we use? We have two 150-psi hrt boilers equipped with dutch ovens burning shavings and sawdust.—*JDW*

2—Does Blowdown From Boiler Contain Steam?

WHAT IS the actual loss in Btu per pound of effluent discharged as boiler blowdown? Some engineers claim that the discharge contains not only water at boiler temperature but also an appreciable quantity of steam bubbles representing latent heat required for actual evaporation.

Possibly boiler design, pressure, circulation and rating may influence amount of steam assumed to be ejected with blowdown water. If the discharge contains no steam how do you determine what percentage of water flashes to steam and the quantity and temperature of the remaining water?—*MFR*

Answers to January Questions

Needs Help on Pulverized Coal Firing

(This is Question 1 from the January issue, with best answers from readers.)

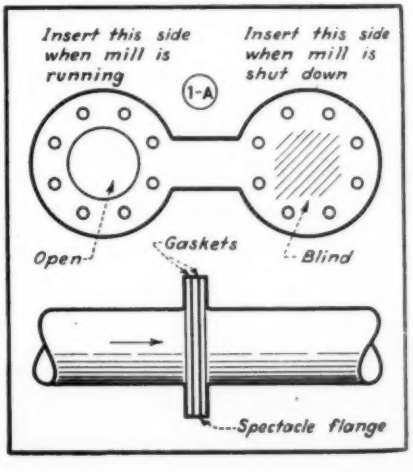
I am faced with the problem of writing operating instructions for our new pulverized-coal-firing equipment. We have one unit for each boiler with a spare for emergencies that is piped to all burner lines. I am well supplied with information on the mechanical operation of this equipment and mainly interested in the safety measures followed by other operating engineers.

For instance, what is the permissible drying-air temperature when it enters or leaves the mill? What can be done to prevent fires in coal piping? What causes fires and what is the best way to extinguish them? Should the practice of lighting a burner from another or from the hot refractory be absolutely prohibited or just warned against? I have certain ideas about these points but would like to have the advice of other engineers.—FCL

Use a Positive Source of Ignition

BURNING OF PULVERIZED COAL is affected by its moisture and volatile content. High moisture delays ignition and makes the fire unstable, particularly at low ratings. To eliminate or greatly reduce this delay in ignition, air at high temperature must be supplied to the mills. With low-moisture coal, air entering the mill at 300 F may be sufficient. With high-moisture bituminous coal, an air temperature of 500 F is desirable; and with lignite, 800 F or higher may be required.

To prevent fires and blowbacks reaching an idle mill where coal dust may be in suspension, insert a pair of



spectacle flanges in the discharge pipe between mill and burner piping, sketch 1-A. Shutting off hot air to the mill and letting it run will snuff out fires in the discharge piping.

The practice of lighting a burner from another or from hot refractory should be absolutely prohibited. Use a dependable source of ignition.

Breaking down eight major causes of 70% of the pulverized-coal accidents shows the number of explosions for each:

During lighting off:	
Poor lighting practice	19
Lighting without purging	19
Inadequate torch	20
During operation:	
Ignition lost, fuel not cut	24
Burners feeding unburned fuel	20
Air reduced and restored	17
After shutdown:	
Unburned fuel	9
Blowing soot	8

Majority of the accidents could probably have been prevented by taking these precautions:

During lighting off:

A. Train operators as follows:
- a. Obtain better ignition conditions such as proper air velocity and ample fuel.
- b. Purge the furnace properly with air.
- c. Always use a torch for lighting.
- d. Maintain an ample torch.
- e. Inspect the torch at frequent intervals.

B. Provide more reliable lighting and burner equipment.

C. Interlock equipment so that it must be started in the proper sequence: induced-draft fan, forced-draft fan, ignition torch and fuel.

D. Automatically insure adequate purging by using a purge meter that requires a specified air flow through the furnace for a specified time interval before the fuel feed can be started.

E. Automatically limit the length of ignition time.

During operation:

A. Train operators as follows:
- a. Keep air and fuel ratio within proper limits.
- b. Cut off fuel when ignition is lost.
- c. Light up additional burners properly.
- d. Cut off ignition torch during operation.
- e. Blow soot only at medium or high ratings so that maximum volume of CO_2 is present in furnace and boiler passes.
- f. Operate at rates sufficient to maintain stable ignition.

B. Provide devices to cut off fuel automatically on flame failure or to sound a warning signal.

C. Provide better combustion control to keep fuel-air ratio within proper limits and prevent damper positions changing in control-system failure.

D. Interlock fans and fuel feed, a typical arrangement being:
- a. If the induced-draft fan fails it trips out the forced-draft fan.
- b. If the forced-draft fan fails, it trips out the fuel feed.

E. Use continuous pilot or torches.

After shutdown:

A. Caution operators as follows:
- a. Do not blow soot when unit is shut down.
- b. Do not run the pulverizer mill for test with the burner lines open.
- c. Do not allow torches to remain in the furnace after shutdown.
- d. Do not allow leaky valves to feed unburned fuel in the furnace.

Install fuel-supply regulators so that failure or accident to the regulator will not increase the fuel supply. Wherever possible provide a shield fitted with wire glass to protect the operator from flareback.

J D Constance

Cliffside Park, N. J.

Interlock Air-Supply Fans

Here are suggestions that may help FCL prepare his operating instructions.

Interlock the induced-draft, forced-draft and primary-air fans and pulverizer feeder to start in this sequence.

Keep pulverizer outlet temperature as low as operation permits; we find 150 F gives good results with bituminous coal. If one operator looks after more than one unit it is advisable to have an alarm contact on the thermometer set at 170 F. This serves to draw attention to an extreme temperature rise that indicates a fire in the pulverizer. Tempering air control should be arranged within easy reach of the operator.

Keep the primary air velocity above its minimum value to prevent (1) fire in delivery pipes (2) coal settling in the lines, which may be picked up on a load increase and smother the furnace fires. After taking a burner out of service clean the throat with air or steam, then leave a vent open to keep the vanes cool.

To prevent mill fires: (1) Watch outlet temperature. (2) Keep tramp iron out of mill. (3) Clean the pyrites trap often. (4) Sweep the mill clear of coal when shutting down. (5) If a forced shutdown is going to last more than 30 min it may be advisable to clean the mill by hand. Allowing fine coal to accumulate anywhere is dangerous; therefore good housekeeping should be the rule.

Lighting one burner from another is questionable and should be discouraged; lighting a coal fire from hot refractory—never!

Should the fire puff or blow out it is important to shut off the secondary air supply with the primary as this greatly lessens the danger of a *puff* in the furnace.

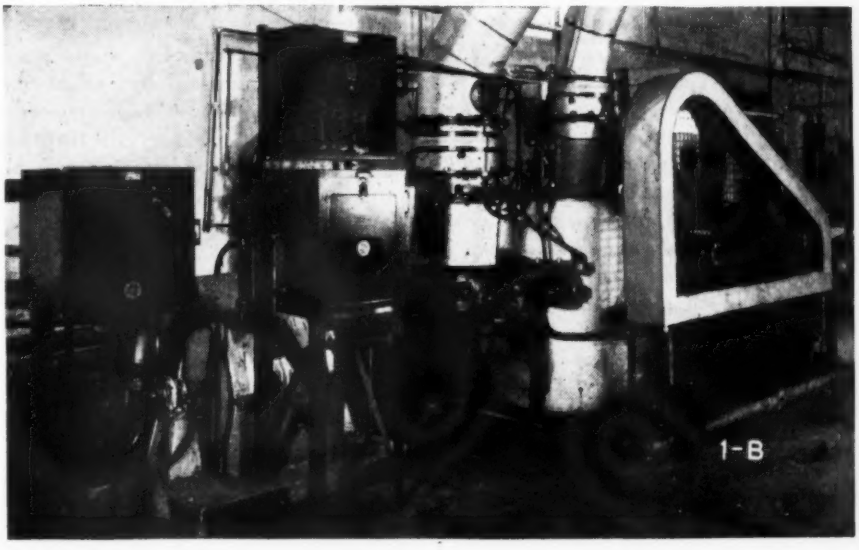
Chicago, Ill. R O Smith

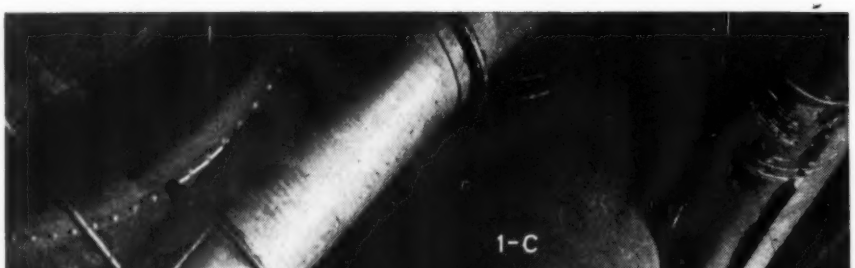
Control Mill Temperature

Individual-unit system located in a special fireproof room, photograph 1-B, eliminates many hazards connected with handling pulverized coal.

Guard against fire in the mill by controlling the heat so that discharge temperature stays below a safe maximum. Most duct fires occur in pockets that collect coal and hold it quiescent until spontaneous combustion takes place. Best preventive is to arrange piping and valves so that no dead spots or obstructions interfere with free coal movement. Burning coal can be detected by feeling the pipe at suspicious points.

If a fire occurs in pulverized-coal conveyors, ducts or collectors stop coal and air supply as quickly as possible and then close other vents or openings through which air can enter. Carbon





dioxide or other inert gas can be introduced to smother the fire. Feed it slowly to prevent creating a coal-dust cloud that may explode. Permanent piping can be connected as shown at *A*, photograph 1-C.

Never use steam indiscriminately to smother coal fires. Use it carefully because if considerable incandescent coke is present, enough hydrogen may form to create an explosive or poisonous atmosphere in a confined space. Water has been used but it not only means considerable cleaning up but is liable to create explosive dust clouds if not handled carefully.

Prevent furnace explosions by running the draft fans long enough to purge the furnace thoroughly of unburned gas and fuel. Then light each burner with a torch and keep the latter in place until the burner functions properly. In general, if a burner does not ignite within 15 to 20 sec shut the fuel off and purge the furnace before making adjustments for relighting.

New York, N. Y. L C RINEHART

Manipulate the Tempering Damper

TEMPERATURE of drying air for pulverizers, which depends largely upon grade of coal, should be maintained as high as possible without causing fires in piping and burners. A high-volatile coal will not stand as high drying-air temperature as one low in volatile content. Most pulverizers have a tempering damper that can be manipulated to maintain any temperature desired. I think it a good idea to hammer burner pipes at least once every two hours to prevent pulverized-fuel accumulation adhering to pipe walls. When a pulverizer is shut down burners for that particular unit should be blown out thoroughly, because furnace heat may ignite pulverized fuel remaining in the star wheel and seriously damage the burner.

If fire starts in a cyclone or pulverizer keep the unit in service with a current of air passing through the latter until all signs of fire have been eliminated. Shutting the unit down under these conditions may cause a serious explosion.

If the boiler is banked with no pulverizer in service, always use torches to ignite the fuel when starting. If more than one unit is to be used in the same boiler the next burner can be lighted from the adjacent burners already in service, provided the latter are burning brightly with a steady flame. Under no conditions should an attempt be made to light burners from hot refractory. This only invites trouble.

For fire in a burner pipe it is imperative that air flow be kept between pulverizer and burner. The pipe should be hammered to loosen up incandescent fuel adhering to walls. If there is an opening in the pipe, blow the burning fuel towards the burner with an air hose. Watch closely so that incandescent fuel does not lodge in the star wheel and ruin the burner.

Duluth, Minn. E R WEBBER

Why Does Ice Crack?

(This is Question 2 from the January issue, with best answers from readers.)

We experience considerable trouble with cracked cakes when we harvest our ice. Varying brine temperature between 12 and 16 F does not correct the trouble. We have been advised to use CO_2 in the water before putting it in the cans. Is this considered good practice, and if so how is the gas piped to the filling tank? It is my understanding that CO_2 in water corrodes pipelines. Does it corrode ice cans?

At present the cracking causes us considerable loss, and we would like suggestions as to what may be causing it and what possible corrections we can make that will correct what is to us a costly condition.—FSW

Suggests Ammonia to Prevent Cracked Ice

NEUTRALIZATION with CO_2 would probably reduce cracking, but might not solve the problem entirely. However CO_2 treatment is seldom practical because few plants have a convenient and economical source of supply.

Water of low mineral content, having neither acidity nor alkalinity, produces practically crack-free ice at freezing temperatures as low as 6 F. Total concentration and chemical nature of the impurities affect the cracking tendency.

Suppose you have a water of 250 ppm total concentration with a pH value of 10.0 and of such nature as to produce cracked ice when frozen. Cracking could be eliminated by adding approximately 15 ppm of ammonia. This is roughly equivalent to one third of an ounce of either ammonium sulphate, ammonium chloride, or 35% of aqua ammonia in each 400-lb can of water. With another water of the same total concentration but of lower alkalinity, the same improvement in cracking tendency could be obtained with one third this dose.

The treatment can be applied by adding the required amount of material to each can of water with a small measuring spoon or cup, which any engineer can make. If one of the ammonium salts is used, a stock solution can be prepared without difficulty. It is advisable to determine by trial the minimum dosage required. Introducing excessive amounts may increase the total mineral content of the water to the point where white ice may give trouble.

There is a rather complete discussion of this subject in University of Illinois Engineering Experiment Station Bulletin 254.

Denver, Colo. K M HOLADAY

Longer Freezing Time

THE TROUBLE FSW is having with cracked ice is definitely caused by rapid freezing. He should remember that the time required for most effective freezing, depending upon ice-cake thickness, is from 36 to 60 hr. Actual comparison between long and short freezing periods will convince him that allowing a longer freezing time improves ice quality and eliminates cracking. Thus he need not spend approximately $1,400 per five tons of icemaking capacity for additional equipment.

CARL BACHMANN

Glenwood Springs, Colo.

Suggests Rearranging Brine Tank Baffles

CRACKING OF ICE harvested from low-temperature brine may be reduced by adding carbon dioxide, or such anti-cracking compounds as Distilex or Templets. These commercial substances toughen ice, much as carbon toughens iron. Their effectiveness depends upon the original hardness of the water in equivalent $CaCO_3$, quantities of other impurities present, amount of lime used in filtration and the violence of air agitation. Added to waters flowing in limestone country, or drawn from wells sunk into limestone or dolomite strata, these treatments reduce the critical cracking temperature two to five degrees.

Ice has two critical cracking temperatures, that at which it cracks under thawing water, and that at which it cracks in the field. For raw-water ice the first may be 20 F or above. The second is usually 10 to 15 degrees lower. The second is fairly constant, while the first varies with the temperature of the thawing water, violence of agitation and uniformity of the thawing procedure.

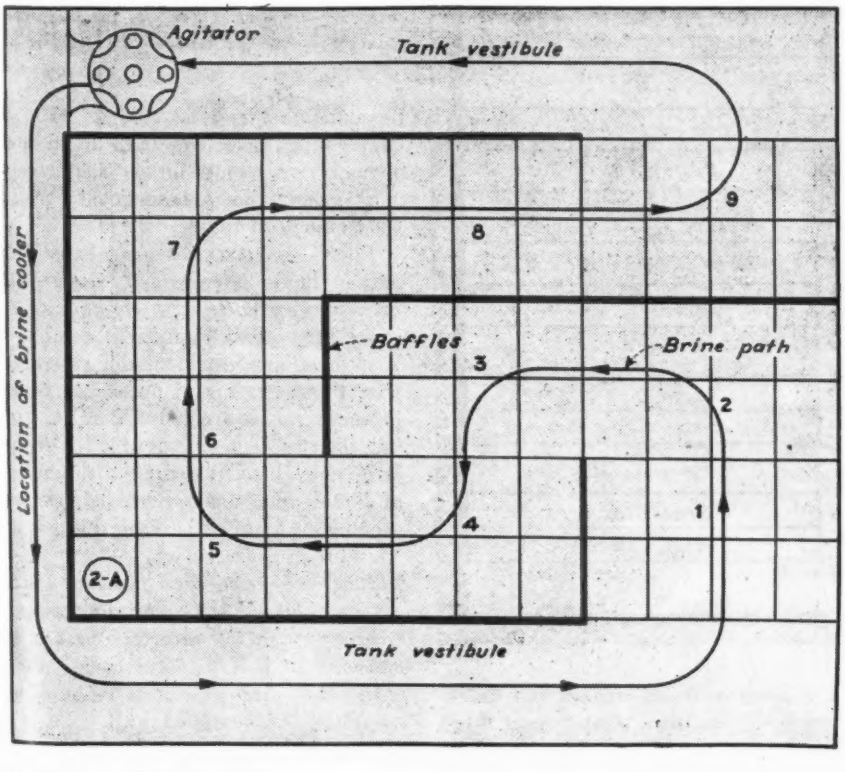
While CO_2 lowers the cracking temperature, it makes the water slightly acid. This acid attacks the zinc coating inside the cans, particularly in the area between water level and the ice expansion point. Zinc carbonate so formed is usually rubbed off as the ice slides from the cans, and the iron begins to rust.

Where possible, best way to combat cracking is by method of harvesting, rather than by treatment. If cans of raw-water ice drawn from 12-F brine can be left in 70-F air for 15 to 20 min, they usually will not crack when lowered into the dip tank or set under the thawing spray. The lower the thawing-water temperature, the less likelihood of cracking.

If the compressor does not operate a full 24 hr, shutting it down for an hour or two before harvesting begins allows the brine temperature to rise. Such rise may be accelerated by harvesting a few racks of ice and returning full cans of water to the area of entering brine, section 1, sketch 2-A. With the compressor idle and agitator running, a ton of water in cans at this point raises the temperature of 10 tons of brine 10 F in less than an hour. This should be above the critical temperature of any raw-water ice.

Proper harvesting procedure depends upon how the field is baffled, sketch 2A. Racks in area 1 should be drawn first, those in area 2 second, etc. Brine is warmed somewhat in passing between the replaced cans of water, and raises the temperature of those containing ice immediately downstream.

Marissa, Ill. GEORGE HOLMAN



Check Temperature Of the Dip Water

BRINE TEMPERATURES of 12 to 16 F are ideal for making good ice. Do not permit temperature of 11 F or lower for any length of time, because too fast freezing makes brittle ice that breaks in handling. I offer two suggestions that may help FSW: (1) When cans are removed from the brine tank they should not be dipped until the dry surface frost has completely thawed off; this may require from one-half to an hour depending on tank-room temperature. (2) Do not have the dip water too warm. That will surely crack the ice. Observation will reveal what water temperature can be used. There may be a slight reduction of tonnage harvested, but less loss from breakage.

ALBERT GASSMANN, SR.

Rochester, N. Y.

Warns Against Use Of Carbon Dioxide

AS BRINE TEMPERATURE is lowered, frozen ice blocks exhibit an increased tendency to crack and shatter when removed from the cans. It is good practice when harvesting to allow the cans to temper in the air for a period ranging from 10 to 60 min. Tempering time depends on brine and harvesting-room temperature. The cans may then be dipped or sprayed with 60- to 80-F water, the temperature selected depending on local operating conditions.

Cracking results from strains developed by unequal expansion of the ice

(*Continued on page* 140)

REFRIGERATION NOTEBOOK — 19

Quick-Freezing of Foods In Locker-Room Service

By TERRY MITCHELL, ME, *Frick Company*

THERE are now between 5500 and 6000 frozen-food locker plants in the country—nearly as many as ice plants. While some locker systems are independent businesses, the majority are operated as part of an ice plant, creamery or meat market. Hundreds have been installed in recent years despite the war; thousands more are still needed to fill customer demands.

Because a complete locker plant includes facilities for processing, chilling, aging, quick-freezing and storing foods, the refrigerating work involves three distinct temperature levels. A 2-stage or booster system is therefore preferable: this carries the quick-freezer, at minus 20 to minus 50 F, and the locker room, at −10 to 0 or + 10 F, on the low-pressure suction, while the chilling and aging rooms are held at 32 to 36 F on the high suction. Many installations, however, still occupy only one room. Here the lockers are placed and in these compartments the food is frozen as it is brought in by patrons. In this case a single compressor usually suffices to take care of the entire refrigerating load.

Ammonia refrigeration is generally recommended for locker work, as it offers better economy and greatest reliability. A small ammonia compressor operating at 5-psi suction (17.2 F) uses only ¾ as much power as a Freon-12 machine, per ton of refrigeration, and only about 2/3 of that required with methyl chloride. At higher temperatures the savings with ammonia are even more marked. However, many small locker plants are operating successfully with low-pressure refrigerating systems, which are economical to install.

The colder the air in the quick-freezer the better, as it can take up so much less moisture from foods, which are also of better quality if rapidly frozen. An air-blast freezer, into which a push-truck carrying the food is rolled, seems the ultimate type. In locker rooms, ceiling coils placed over the aisles are preferred. Either coils or cold-air units of ample size are acceptable in the higher-temperature rooms. In the South, salt-pork curing rooms, held at 38 F, may be included in the layout.

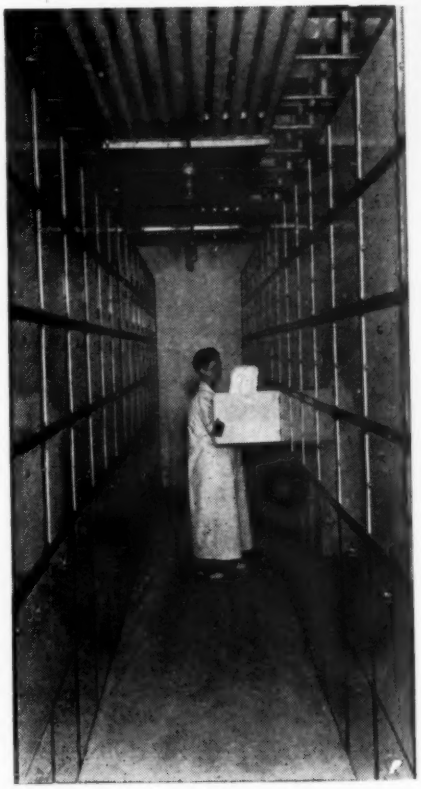


Fig. 2—In locker rooms, ceiling coils placed over the aisles are preferred

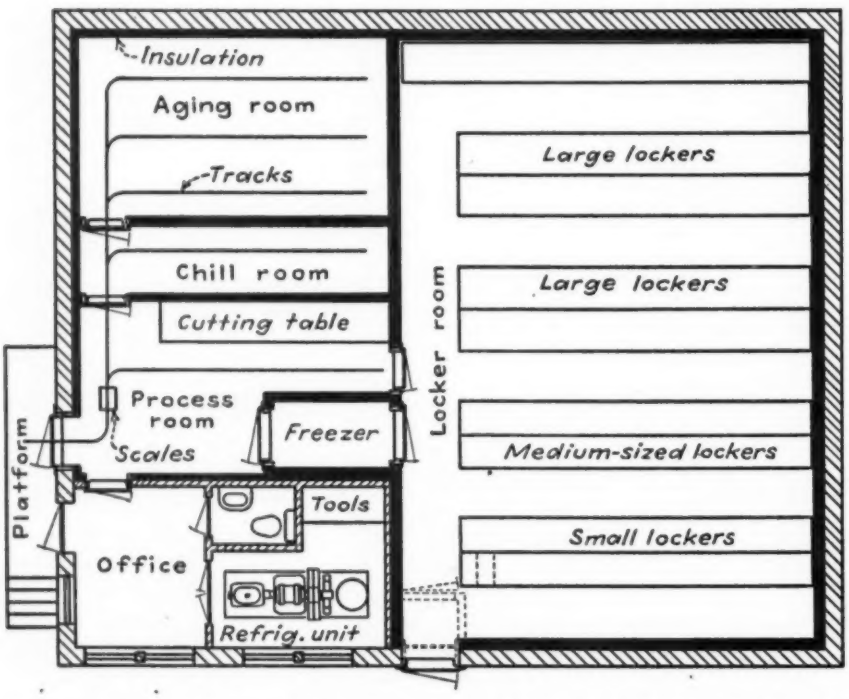
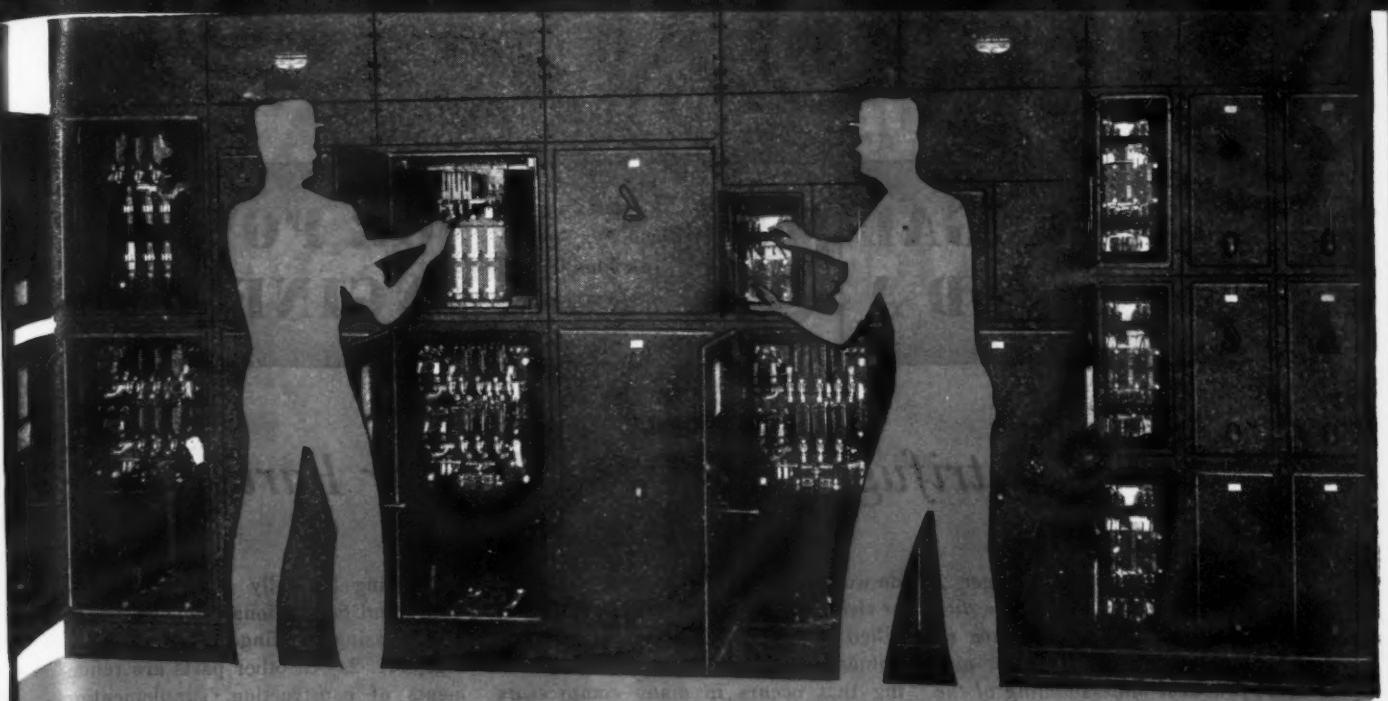


Fig. 1—For complete service to customers, a plant includes lockers and quick-freezing, aging, chilling and processing rooms involving three temperature levels

Float or thermostatic expansion valves should be provided, along with other devices such as safety cutouts, to make the cooling equipment completely automatic. Electric shutoff valves, 3-wire thermostats, and automatic back-pressure valves are helpful in controlling the various temperatures. Receivers large enough to hold the entire charge of liquid ammonia are needed, as are pipelines of sufficient size to prevent wasteful pressure losses.

State laws have been put into effect in some places regarding locker and freezer-room temperatures; these regulations, as well as local codes about wiring and fire protection, should be consulted and complied with.



WHEN MOTOR CONTROL IS UNITROL

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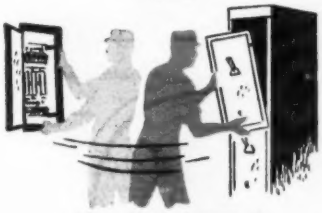

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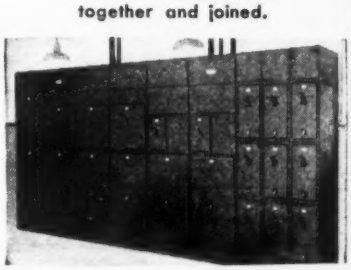

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CENTRIFUGAL PUMP Q AND A

By I J Karassik and Roy Carter
Worthington application engineers

FOR POWER ENGINEERS

1—*Centrifugal Pumps and Their Parts*

First in a monthly series by Igor J Karassik and Roy Carter. These two experts on centrifugal pumps have selected questions and answers that give a broad, practical understanding of the pumps, their construction, operation, characteristics, troubles and remedies. Here is a study course of inestimable value to newcomers in the field and a way for practical engineers to keep posted on sound working principles and developments in this important field.

Q 1—*What is meant by pumping?*

A—Pumping is the addition of energy to a fluid to move it from one point to another and not, as is frequently thought, the addition of pressure. Since energy is capacity to do work, the addition of energy to a fluid causes it to do work, such as flowing through a pipe or rising to a higher level. In the closely allied field of centrifugal compressors, "pumping" describes an unstable surging that occurs in many compressors at partial capacity.

Q 2—*What is a centrifugal pump?*

A—It is one that employs centrifugal force for pumping liquids. Liquid coming in at the center (eye) of the impeller, Fig. 1, is picked up by the vanes and accelerated to a high velocity by impeller rotation and thrown out by centrifugal force into an annular channel, or volute, and to the discharge, as indicated.

Q 3—*What are the essential structural elements of any centrifugal pump?*

A—They are the rotating element, comprising basically a shaft and impeller and the stationary element made up of casing, stuffing boxes and bearings, Fig. 2. All other parts are refinements of construction, supplementing the function of the main elements mentioned.

Q 4—*How are centrifugal pumps classified?*

A—They are classified according to:

1. Type of energy conversion: (A) volute (B) diffuser or turbine.
2. Number of stages: (A) single-stage (B) multi-stage.
3. Impeller type: (A) single or double-suction (B) open, semi-closed, or closed (C) single- or double-curvature vanes.

(*Continued on page* 118)

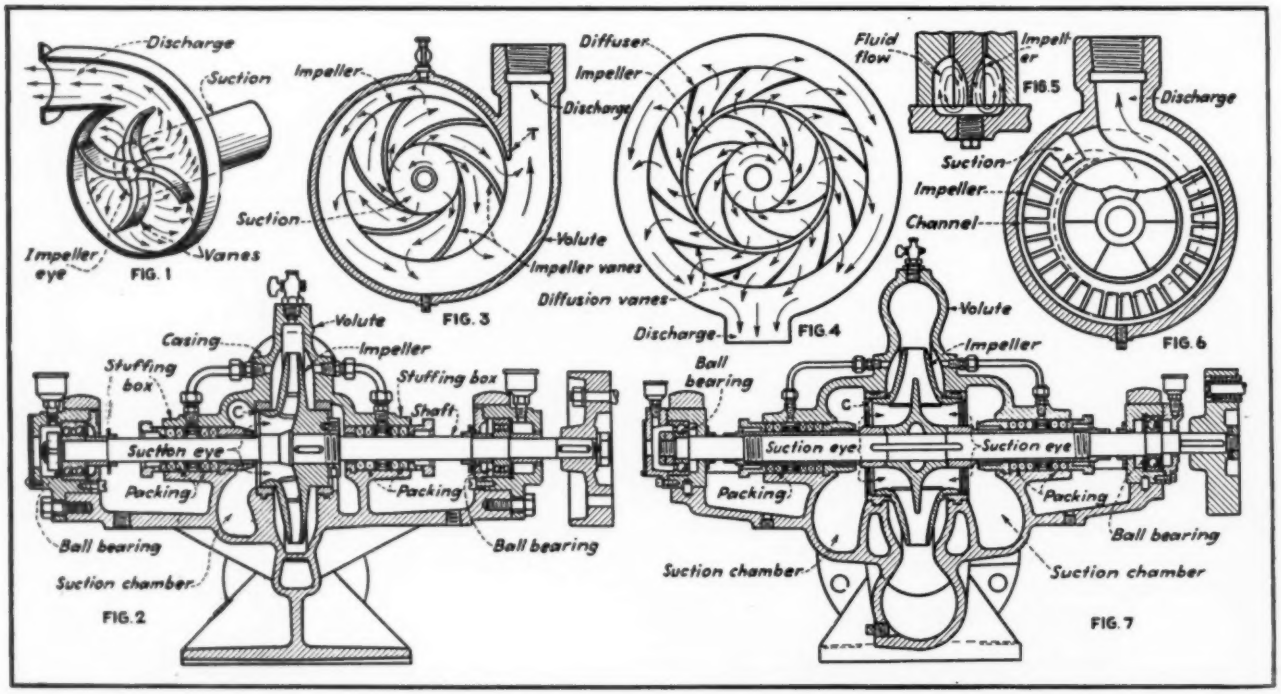

Fig. 1—Diagram shows how a centrifugal pump operates. Fig. 2—Cross-section through single-suction single-stage centrifugal pump. Fig. 3—Cross-section through a volute centrifugal pump. Fig. 4—Diagram of a diffuser centrifugal pump. Fig. 5—Section of fluid channel in turbine pump (see Fig. 6) showing how fluid circulates between impeller vanes. Fig. 6—Turbine pump in which fluid taken in at the suction makes nearly complete revolution in casing and impeller before being discharged. Fig. 7—Cross-section, double-suction single-stage centrifugal pump

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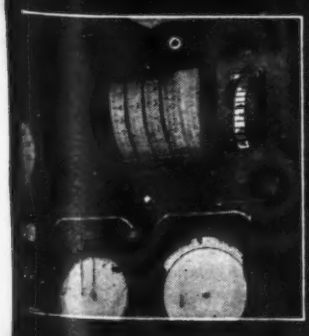
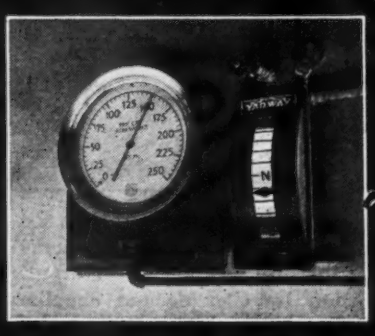
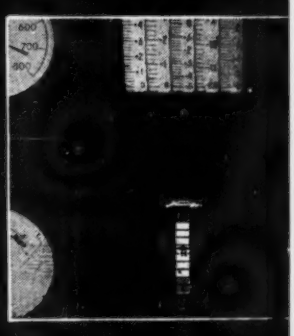






YARWAY REMOTE LIQUID LEVEL INDICATOR

PUMP Q AND A

(*Continued from page* 116)

4. Axis of rotation. (A) horizontal (B) vertical (C) inclined.

5. Casing: (A) solid or split (B) location of suction and discharge nozzles.

6. Method of drive: (A) direct-connected (coupled or close-coupled) (B) geared (C) chain or belted.

There are other classifications such as classes of service, features of construction and rotation.

Q 5—*What is a volute-type centrifugal pump?*

A—A pump named from its spiral-volute form of casing, Fig. 3, which acts as a collector for the fluid discharged by the impeller. Wall *T*, dividing the beginning of the volute and the discharge nozzle, is called the volute tongue or cut-water.

Q 6—*What is a diffuser-type centrifugal pump?*

A—In this pump diffusion vanes, Fig. 4, convert velocity energy imparted to the liquid by the impeller into pressure energy. The diffusion-vane assembly is known as a diffuser.

Q 7—*What is a turbine-type pump?*

A—The name, turbine pump, applies to two different designs. One, a centrifugal design, is now generally called a diffuser type, Fig. 4, except in centrifugal deep-well pumps which are regularly called deep-well turbine pumps. The peripheral-turbine, Fig. 6, also called vortex and turbulence, or regenerative type, is not strictly a centrifugal pump. This pump starts to act on the liquid at one point on the rotor periphery and discharges it at another. Fig. 5 shows a cross-section of the impeller and pump-casing channel, also

ABOUT THE AUTHORS

IGOR J KARASSIK is an application engineer in the centrifugal pump division, Worthington Pump & Machinery Corp.

Born in Russia, he later migrated to Turkey and then to Paris, where he graduated from high school. Coming to the U. S., he received BS and Master's degrees from Carnegie Institute of Technology.

Since 1934 he has worked for Worthington on centrifugal pumps, specializing in high-pressure applications. He has written many centrifugal pump articles for technical publications.

ROY CARTER is also a centrifugal-pump application engineer with Worthington.

Born in Scranton, Pa., he has AB and ME degrees from Columbia University. In 1923 he went with Worthington and for some time was in the centrifugal-pump section of the Harrison Works engineering dept.

When the division to handle application engineering was established he was transferred to it. Here he has specialized in the application of centrifugal pumps for water works, sewage, drainage and irrigation services.

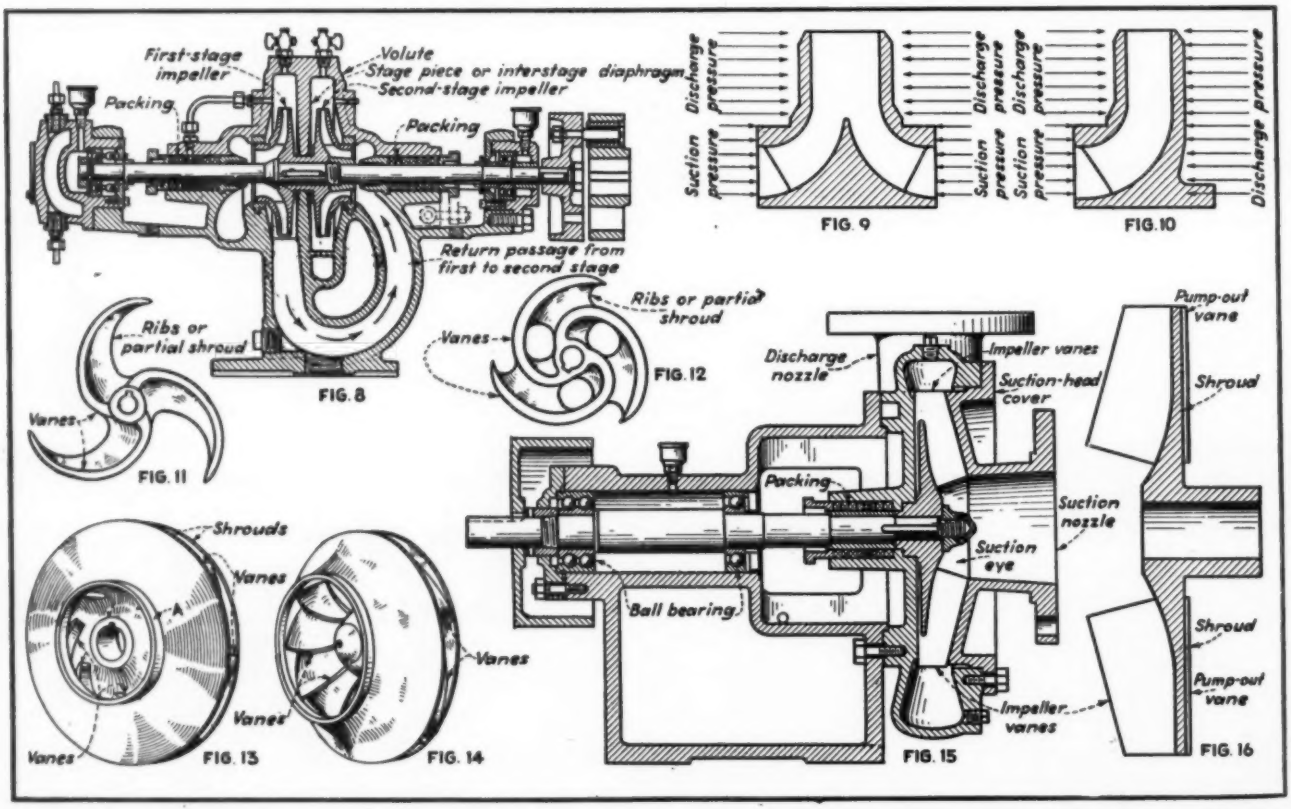
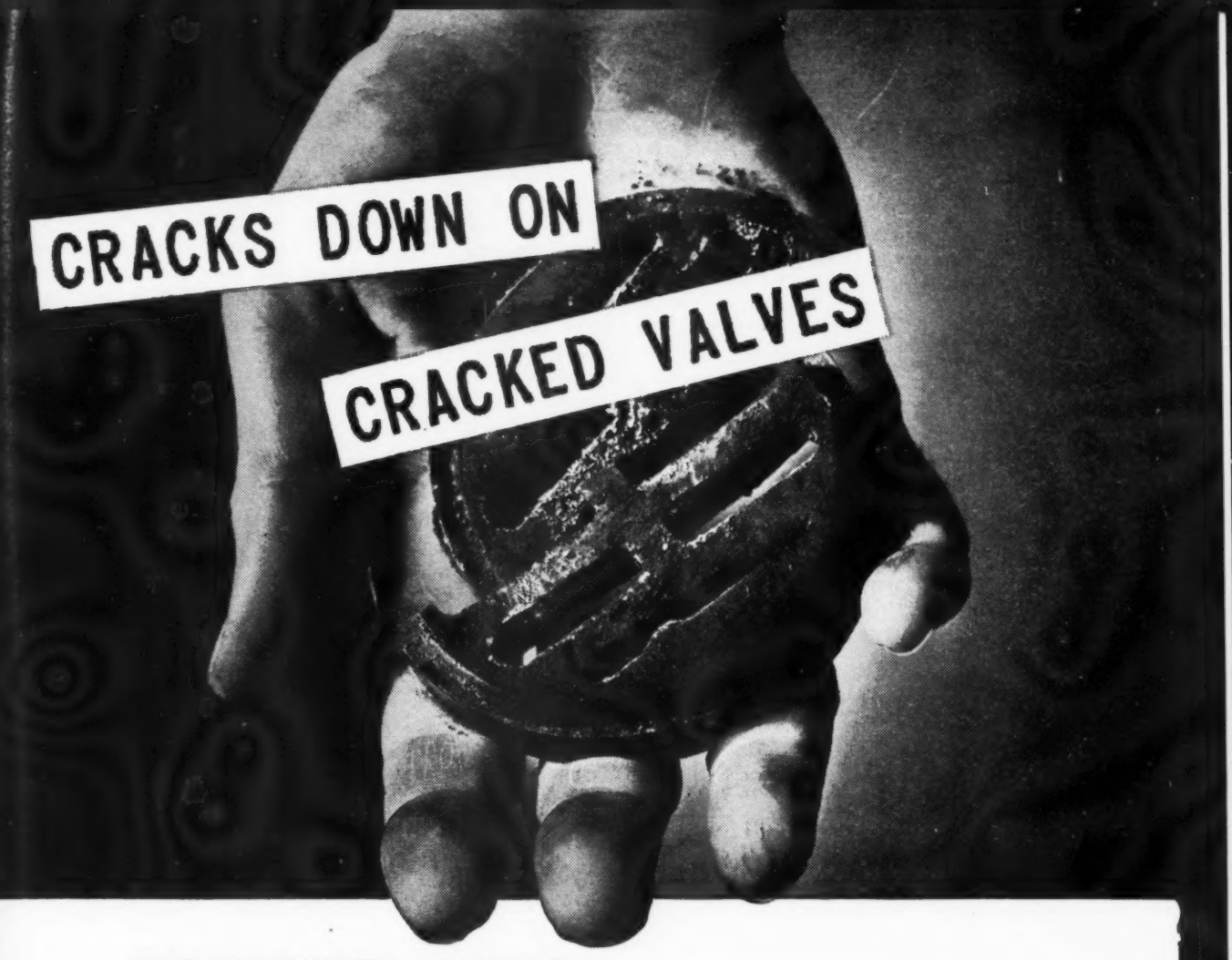


Fig. 8—Single-suction 2-stage centrifugal pump. Fig. 9—Axial hydraulic forces acting on one side of double-suction impeller equalize those on the other. Fig. 10—Hydraulic forces acting on single-action impeller do not equalize, therefore produce resultant axial thrust. Fig. 11 and 12—So-called open impellers with partial shrouds or ribs between vanes to strengthen them. Fig. 13—Closed impeller. Fig. 14—Francis-vane or francis-screw-vane impeller. Fig. 15—End-suction radial-split-case pump with overhung impeller. Fig. 16—Cross-section through semi-open impeller



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PUMP Q AND A

(*Continued from page* 118)

how the fluid circulates in this channel moving between suction and discharge.

Q 8—*What is a single-stage pump?*

A—One in which the total head is developed by a single impeller, Fig 2 and 7.

Q 9—*What is a multi-stage pump?*

A—If the total head required is too high for a single impeller to produce, two or more impellers (or pumps) may be used in series, the second impeller taking its suction from the first impeller's discharge, Fig. 8. If all impellers acting in series are in a single casing, the pump is a multi-stage design.

Q 10—*What is a bi-rotor pump?*

A—Bi-rotor and even tri-rotor designs were fairly common in the early development of centrifugal pumps. These pumps were, in effect, two one-half or three one-third capacity pumps in one casing operating in parallel.

Q 11—*What is a single-suction impeller?*

A—It is one in which the liquid pumped enters the impeller from one side, Fig. 2.

Q 12—*What is a double-suction impeller?*

A—It is, in effect, two single-suction impellers cast back to back so that liquid enters the impeller simultaneously from both sides, Fig. 7. Normally, the suction chambers, one at each side of the impeller, connect to a common suction passage and nozzle. Some large pumps have two separate suction passages and nozzles connected to opposite sides of a double-suction impeller. This construction was used in the early development of double-suction pumps for units quite small in size.

Q 13—*What are the advantages of double-suction and single-suction impellers?*

A—In general service, a double-suction impeller is favored in single-stage horizontally-split-casing designs. It is theoretically in axial hydraulic balance, as indicated in Fig. 9, making an oversized thrust bearing unnecessary. The greater suction area in a double-suction impeller permits the pump to operate with less net absolute suction head for a given capacity than with a single-suction impeller. For manufacturing reasons the single-suction impeller is more practical than the double suction in small pumps because the water ways are double size and not divided into two; but they require a larger thrust bearing to take the unbalanced axial thrust, Fig. 10, or balancing ports.

End-suction pumps with single-suction overhung impellers, Fig. 15, have advantages that cannot be obtained with a double-suction impeller, and thus, in general, pumps with radially split casings have single-suction impellers. Because with an overhung impeller the shaft does not extend into the suction eye, single-suction impellers are almost always used for pumps handling liquids containing suspended matter, such as sewage.

Q 14—*What is an open impeller?*

A—Strictly speaking, one that consists of vanes only, attached to a central hub without any form of side wall or shroud. With long vanes this design is structurally weak and the vanes have to be strengthened by ribs or a partial shroud, Fig. 11 and 12. Generally, open impellers are used in small inexpensive pumps or in those handling abrasive liquids. The impeller rotates between side plates in the volute-casing walls or between the stuffing-box and suction-head covers, Fig. 15. Because of the clearance between impeller vanes and side walls, water slippage occurs similar to that in a reciprocating pump, which increases with wear. Restoring original efficiency requires replacing both impeller and the side plates, which costs more than replacing sealing rings in a closed-impeller pump.

Q 15—*What is a semi-open impeller?*

A—One that has a shroud, or wall on one side only, Fig. 15 and 16. This shroud may or may not have pump-out vanes, Fig. 16, to reduce pressure on the stuffing box of single-suction pumps and prevent solid material lodging behind the impeller.

Q 16—*What is a closed impeller?*

A—This design, used almost universally in centrifugal pumps handling clear liquids, has shrouds on each side that totally inclose the waterways from the suction-eye to the impeller's periph-

(*Continued on page* 136)

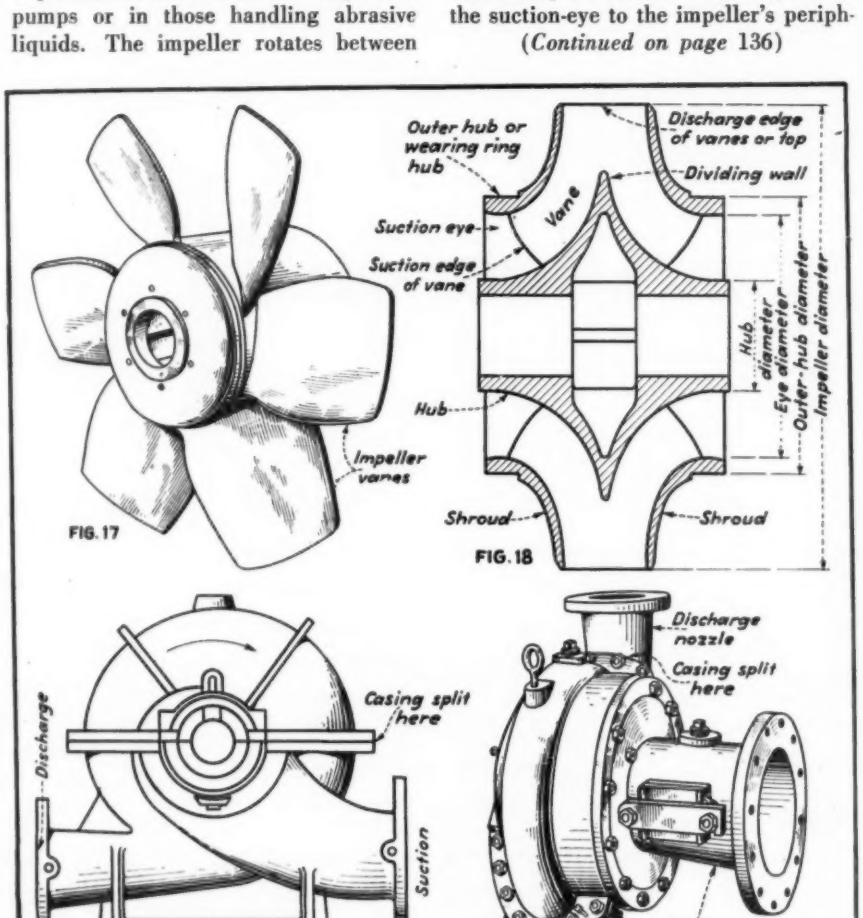

FIG. 17 FIG. 18 FIG. 19 FIG. 20

Fig. 17—Propeller-type, or axial-flow, impeller. Fig. 18—Parts of double-suction impeller. Fig. 19—Horizontally split case has suction and discharge in bottom half. Fig. 20—Horizontal-shaft end-suction pump with casing split along plane passing through its axis but inclined from horizontal

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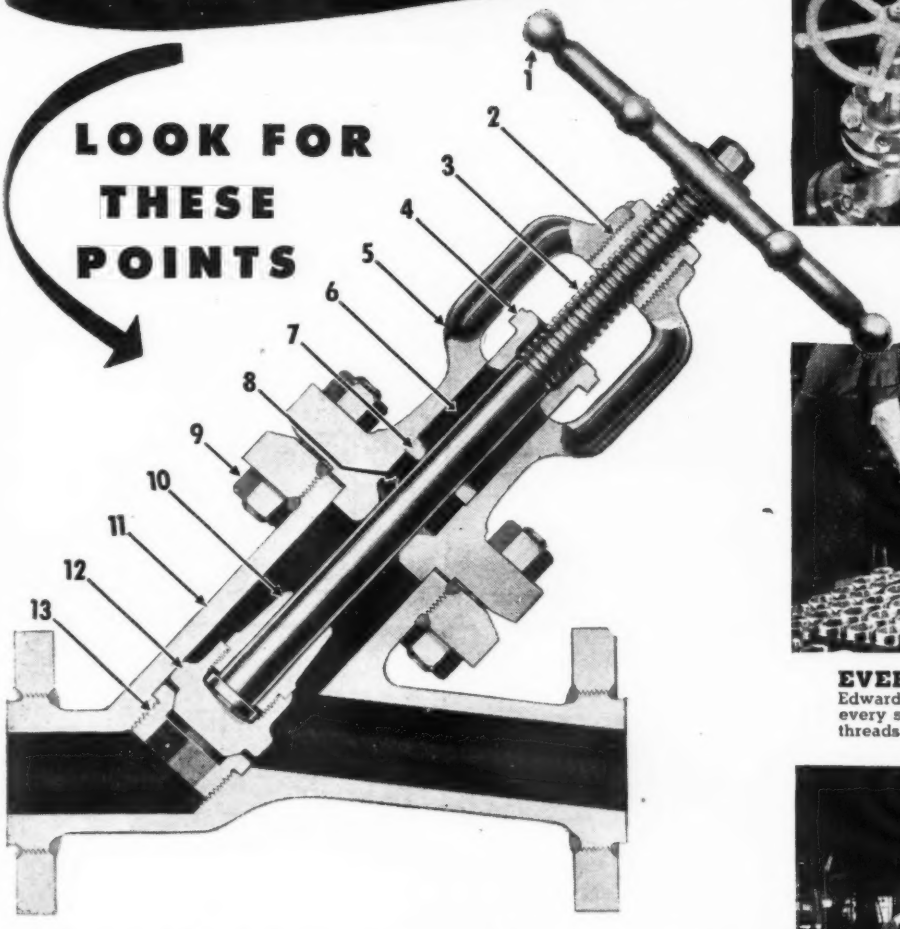

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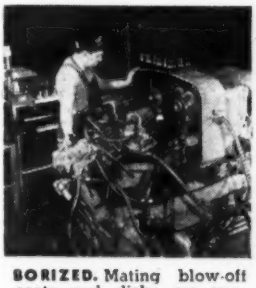

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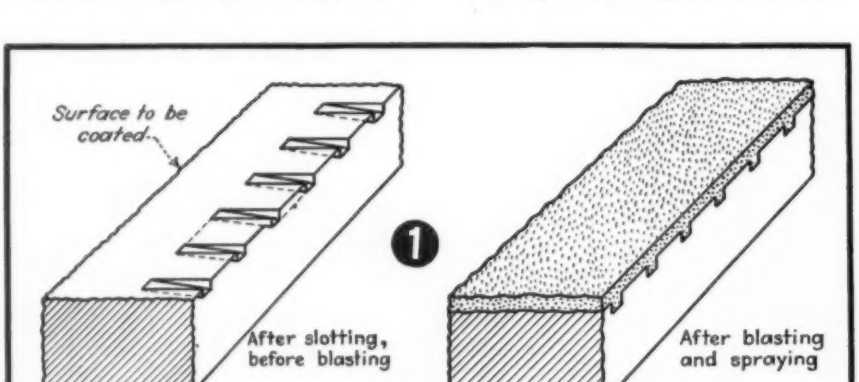
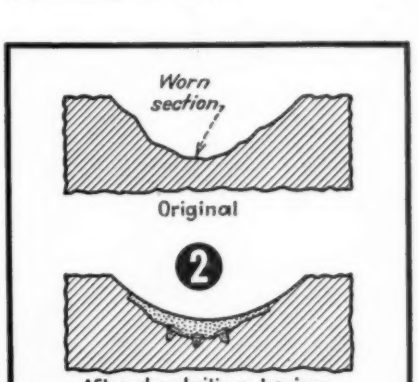
HOW TO KEY AND BOND SPRAYED METAL

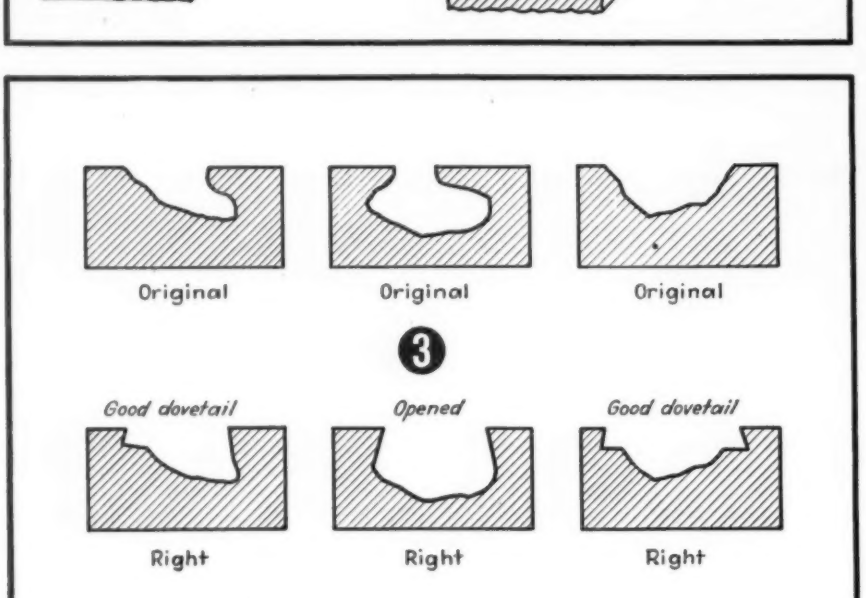
METALIZING provides one method of restoring worn parts, protecting equipment against corrosion, salvaging mismachined work, and applying a metal surface to nonmetallic material.

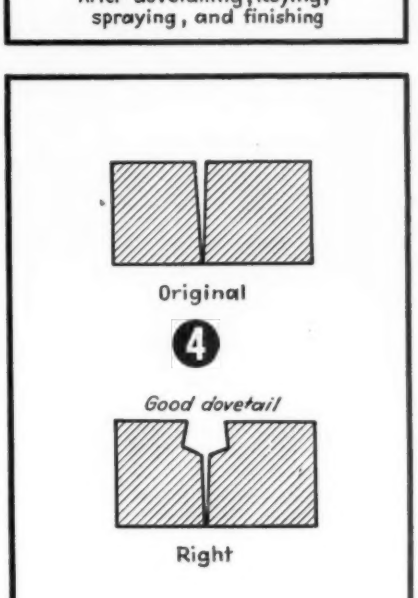
But as with other specialized processes, successful application depends upon careful technique—not only in spraying but also in choosing the correct spray metal, preparing the surface and finishing the job.

Bonding surface of parent metal must be free of oxides, oil, water and other foreign matter, and roughened so that spray metal attaches itself firmly. Cut keyways or dovetail slots before sandblasting.—*Courtesy of the Metallizing Engineering Co, Inc.*









1 One way to bond sprayed metal to a corner is to saw or slot dovetails in the edge. Use either a hand or power hacksaw having a blade at least 1/16 in. thick. Make the slot wider than it is deep, and slightly wider at the bottom than at the top. For light coats space the slots from ½ to 1 in., for heavy ones use ¼-in. spacing. (Fuse bonding can be used to roughen the surface before spraying. This eliminates slotting and sandblasting.)

2 Flat head screws, of substantially the same metal as that used for spraying, give solid anchorage for heavy coatings on concave surfaces such as cavitated areas in pump housings. Always insert the screws before blasting the surface.

3 When repairing blowholes, chisel out the spot and undercut around the edge. Always make the hole opening large enough so that interior surface can be thoroughly sandblasted and sprayed. If the opening is left small, spray metal may bridge over.

4 Enlarge surface openings of cracks by chiseling out and undercutting the metal along crack line. Then drill a small hole at each end of the crack to prevent it progressing. Surface opening must be wide enough to prevent spray metal bridging over and leaving the hole beneath unfilled.

BALDWIN *diesel engine*

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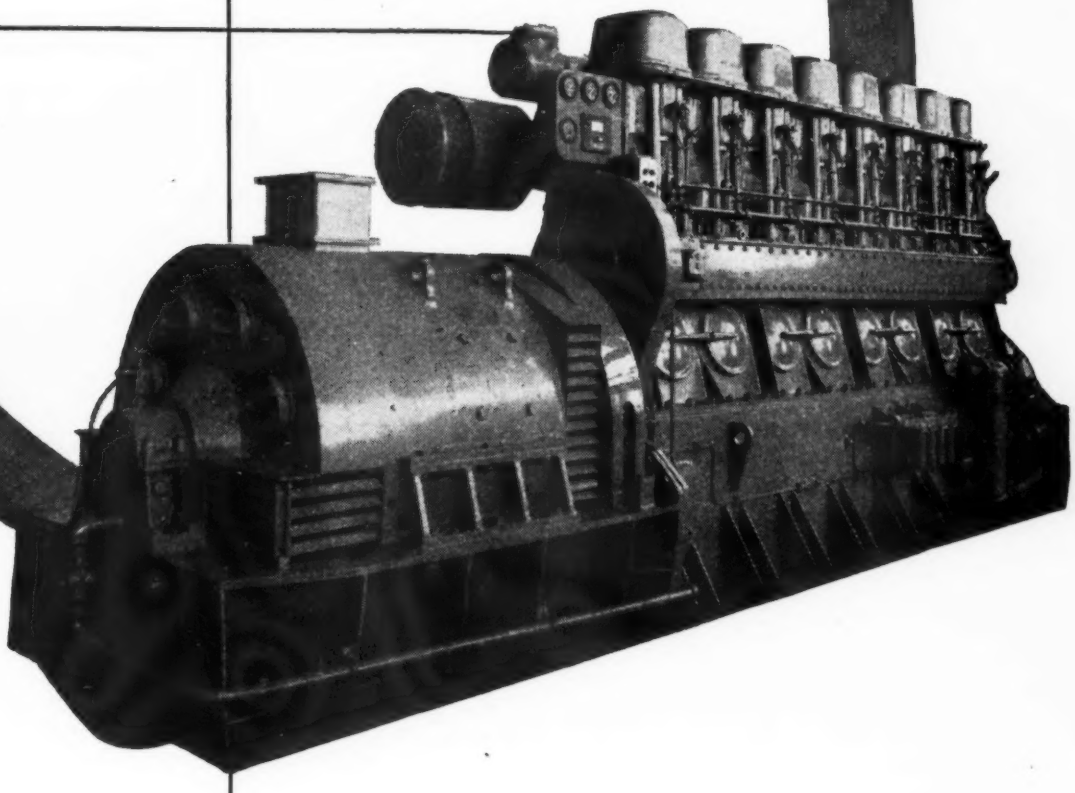
150 to 1,050 horsepower



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BALDWIN
DIESEL ENGINES

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Oldtimer Salutes New Liberty Ship

YOUNG ENGINEERS making adjustments on Liberty ship engines and boilers (POWER, 1943) brought back memories of triple up-and-downers with pumps on the beam, to a boiler inspector who had arrived at man's allotted life span. Watertube boilers didn't exactly fit into the picture like the old Scotch boilers that could stand a density up to floating a potato. Moreover, the same boiler, which does well now with an added bottom row of 4-in. tubes, had frequent failures in the 535's when they were built after World War I.

Experienced marine engineers were badly needed in 1943 so the nostalgic old boy, whose chief engineer's license had expired, again took the exam and received a new, unlimited tonnage certificate. Pronounced physically fit by the doctors and mentally off by his wife, he joined his Liberty ship.

During a year of trips to British and Mediterranean ports in some of the North Atlantic's dirtiest storms, the boilers gave no trouble whatever; he had vivid recollections of old Scotch boilers with leaky combustion chambers and other ailments.

Steaming back without cargo tested the engines severely and many hours were put in at the throttle, but they came through magnificently with no breakdowns. The welded hull took a lot of punishment, as decks were loaded to the limit with trucks, invasion barges, tow boats and even locomotives, over which temporary gangways led to steering gear and for'd and aft guns. Life boats were damaged, rafts lost, quarters flooded. Twice the ship dropped out of convoy to secure booms that had broken loose from masthead clamps. But with all the buffeting there was never any water in the bilges or double bottom. The shipyards had done a speedy job well.

The oldtimer is proud to carry on, to answer questions junior engineers think up. Racks on messroom tables and wet tablecloths to keep crockery from sliding remind him of old times. But electric toasters and percolators in the engine room, sitting on watch, electric irons for sailors' pants, with frequent fuse blowing, don't look just right. Messroom radios might switch to a boiler shop instead of crooning about dream girls.

Each voyage brings changes. Young fellows go back to academies or take exams for higher grade certificates; others celebrate a fat bonus and overtime. Many high-school-trained cadets and oilers expect a janitor to restore tools to their proper place. But by and large the oldtimer gets pleasure when they bring problems to him or rig up indicators for their studies and work out a card.

JAMES MCDONALD
North Quincy, Mass.

Temperature Conversions

IN QUESTION 7 on page 116, Dec, 1944, POWER, a method is given for converting temperature readings in centigrade degrees to Fahrenheit degrees.

There is a much better way to do this. Add 40 to centrigrade reading; multiply by 1.8; then subtract 40. Remainder is the corresponding Fahrenheit reading.

The procedure for converting from Fahrenheit to centigrade is identical, except that the 1.8 operator is used to divide instead of to multiply. The steps are, therefore, these:

Add 40 to Fahrenheit reading; divide by 1.8; then subtract 40. Remainder is the corresponding centigrade reading.

Since all the steps but one are the same whichever way the conversion is to be made, there is no need for the occasional user to review the whole subject each time. The decision as to whether to divide by 1.8, or multiply, is easily reached when you recall that it takes 180 Fahrenheit degrees to make 100 centrigrade degrees.

The objections to the other method are twofold.

1. 32 is added in one conversion and subtracted in the other.

2. The 1.8 ratio operates on a parenthetical expression in one conversion and not in the other. And the decision as to whether to divide or to multiply by 1.8 has to be made here as well as in the simpler method.

POWER is one of my favorite publications, and this series by Alex Higgins is well worth while. It presents things simply and clearly, which is our greatest need.

Hamilton, Ohio R J MACMEEKIN
Chief engineer, Economy Pump Co

Motor and Capacitor Have Leading Pf

I BELIEVE AWM can trace his trouble to the capacitor on the 25-hp motor, as the feeder load and power factor are low at the same period that this motor draws excessive current (Reader's Problems, p 838, Dec, 1944).

The 15-kva capacitor used seems to be oversize for a 25-hp motor on a compressor drive with a normal pf of 85 or better. Quite likely some condition causes the combination motor and capacitor to have a leading power factor. This builds up the excess current and causes the overload relays to operate.

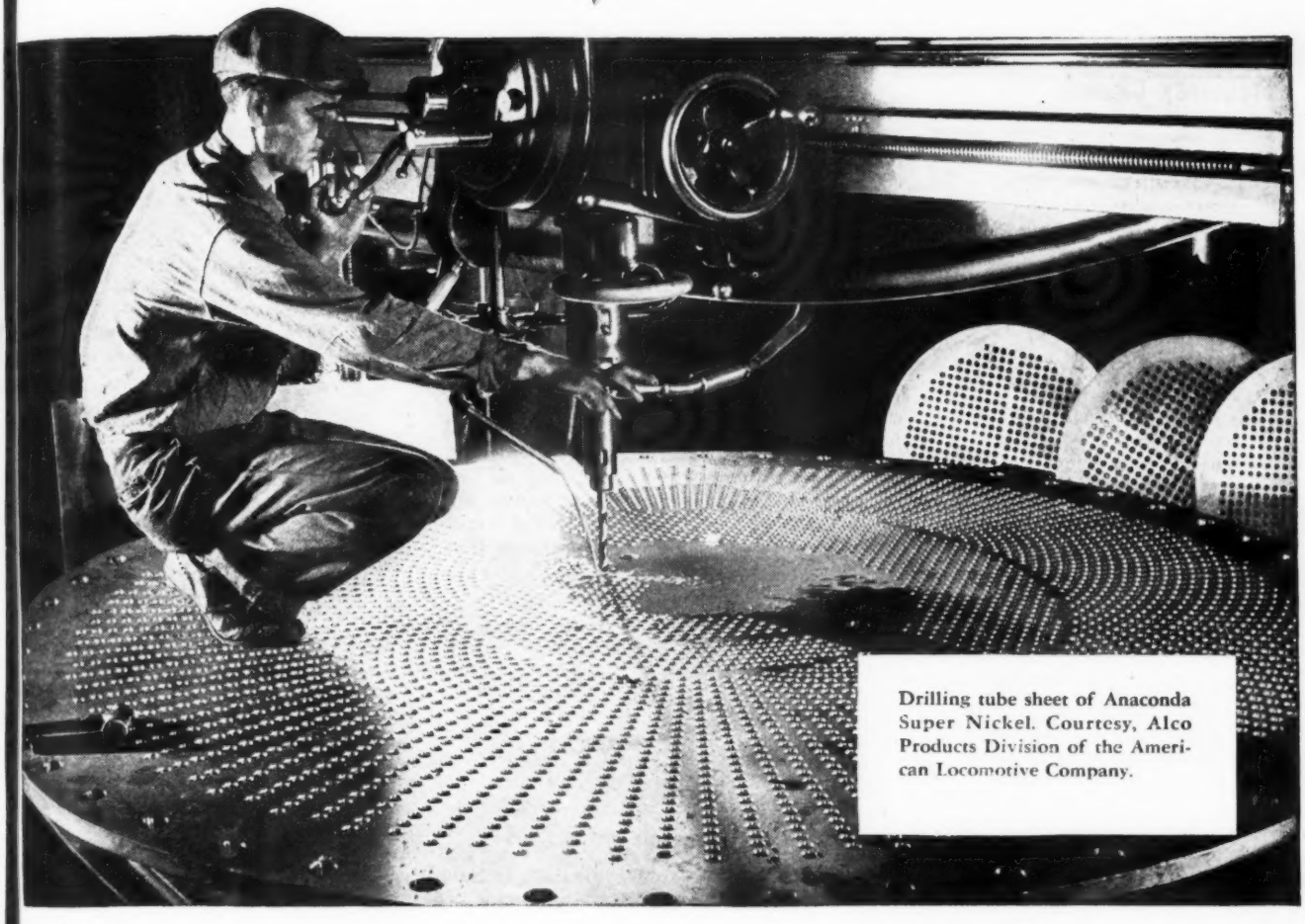
I suggest that the customer disconnect the capacitor and operate the motor for a few weeks to prove the above theory. If successful, the capacitor can be moved to a point near the service entrance. Here the capacitor current will not pass through the motor protective relays. I also believe this will prevent high-voltage surges when motor and capacitor are disconnected from the line. These surges could damage the windings of the 25-hp and 40-hp motors if the main-entrance ocb should be opened by sudden overload or lightening.

It would be interesting to reduce the field current on the 40-hp synchronous motor until the stator current was equal to the nameplate rating. This might have a beneficial effect on the 25-hp motor.

I had similar trouble recently when a local diesel plant tied in with a large power system over a peak-load period. The operator neglected to adjust the voltage regulators, so diesel units tried to feed a large amount of reactive current into the power system. The tieline amperes exceeding the relay setting and opening the tie ocb isolated the two systems. The synchronizing point was 20 miles from the diesel plant and so

(*Continued on page* 148)

It takes *FIGHTING METAL* to back up Fighting Men



Drilling tube sheet of Anaconda Super Nickel. Courtesy, Alco Products Division of the American Locomotive Company.

• And that's the kind of metal that Anaconda Plates for condenser tube sheets, head plates and baffles are made of. These plates can be supplied in rectangular, square, circular, half-circles, segments, or special shapes. The same careful technical supervision used to control the manufacture of Anaconda Condenser Tubes is given to these materials during production.

As a result, Anaconda Plates and Circles are accurately alloyed, commercially flat, true to dimensions, readily machined, unsurpassed in soundness and close-grained structure. They are made in several copper alloys in widths up to 132 inches (circular plates to 138 inches) and in weights up to 9,000 lb.

When specifications call for extremely large plates for special applications, The American Brass Company will gladly cooperate in the solution of such problems. 4498

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What's New in Plant Equipment

Frequency Changer

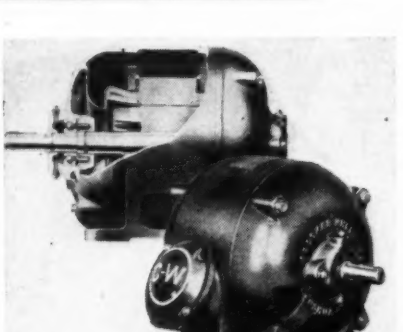
MERCURY-ARC CONVERTER fills out low-frequency range of electronic equipment for induction-heating applications. Designed for electronically changing power at frequencies of 60 or 25 cycles into 1000 to 2000 cycle power, frequency changer is particularly suitable for supplying power for forging, melting and metal-treating applications where large masses of metal or metal parts must be efficiently heated with this power at kilowatt capacities of 250, 500, 1000 and higher. Units operate quietly and require no ventilation or air filtering as they are water cooled. They offer no vibration problems and therefore do not require heavy and expensive foundations. *Allis-Chalmers Mfg Co, Milwaukee, Wis.*

Small Generators

LINE OF SMALL revolving-field ac generators is built in sizes of 6.25 kva, 1800 and 1200 rpm, to 18.7 kva, 1800 rpm, single and three phase, 120, 120/208, 240 and 600 v. They can be supplied as 2-bearing units for belted or coupled duty, or single-bearing for close coupling to driving engine. Dripproof generator and exciter construction is standard. *Electric Machinery Mfg Co, Minneapolis 13, Minn.*

Protected Motor

RATED 40 C RISE, full-load continuous-duty motor combines surplus capacity of conventional open motor with protection against dripping liquid, falling metal chips and other foreign matter. There are no openings in frame or shields above horizontal center line. This, together with shielded construction of ventilating openings, makes motor suitable for machine tool and similar applications. Centrifugal seals permit use of softer grease for better lubrication and longer bearing life. *Alucast* rotor construction, in which bars, fans and end rings are cast in one operation from aluminum alloys, is employed. Other features include: heavy cast-frame construction, coils protected by vinyl acetal insulation, interchangeable



front and rear shields, and specially designed guides for directing cooling air over all surfaces. At present, these motors are in sizes up to and including the 284 frame. *Crocker-Wheeler Div, Joshua Hendy Iron Works, Ampere, N. J.*

Ash-Handling System

SEVERAL NEW DESIGN features are incorporated in Beaumont *Vac-Veyor* pneumatic ash-handling system for automatic removal of ashes, flyash and soot. Ash receiver, separator and air washer are now combined in one unit and installed on silo top. Steam exhauster is in pipeline where it enters receiver. Ash, steam and air mixture enters circular receiver tangentially at high velocity, and centrifugal action throws all heavy ash particles out of steam and air before mixture has traveled more than half way around receiver. Ash falls directly into silo while baffle plates in separator, in conjunction with greatly reduced steam-air velocities, cause practically all of light ash to settle into silo through conical baffle. Steam-air mixture then passes into washer, where any remaining light flash can be removed by sprays and washed away through 4-in. pipeline. However, separating action that takes place in receiver and separator is so effective that in most installations, the manufacturer claims, it is not necessary to use sprays in air washer.

In operation, steam imparts enough moisture to the ash to settle out practically all light ash. There is, however, no wetting of the material, which minimizes possibility of packing and freezing in silo. *Beaumont Birch Co, 1505 Race St, Philadelphia 2, Pa.*

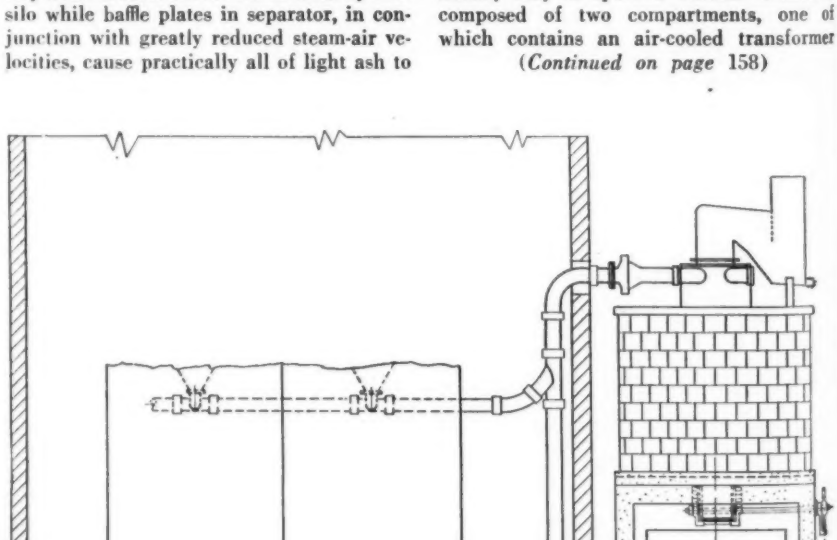
Electronic Heater

NEW 50-KW ELECTRONIC HEATER is suitable for surface and localized hardening of gears, rods and other parts, and for annealing, brazing and soldering operations. Heater incorporates all important features of 5-

and 15-kw GE heaters and, in addition, is capable of heat-treating much larger parts or the same size parts in less time. It is readily applicable for many different heating jobs merely by changing the induction-coil fixture.

Available in models rated either 230 or 460 v, 3 phase, 60 cycles, this heater is unusually easy to operate. Heater cabinet is composed of two compartments, one of which contains an air-cooled transformer

(*Continued on page* 158)



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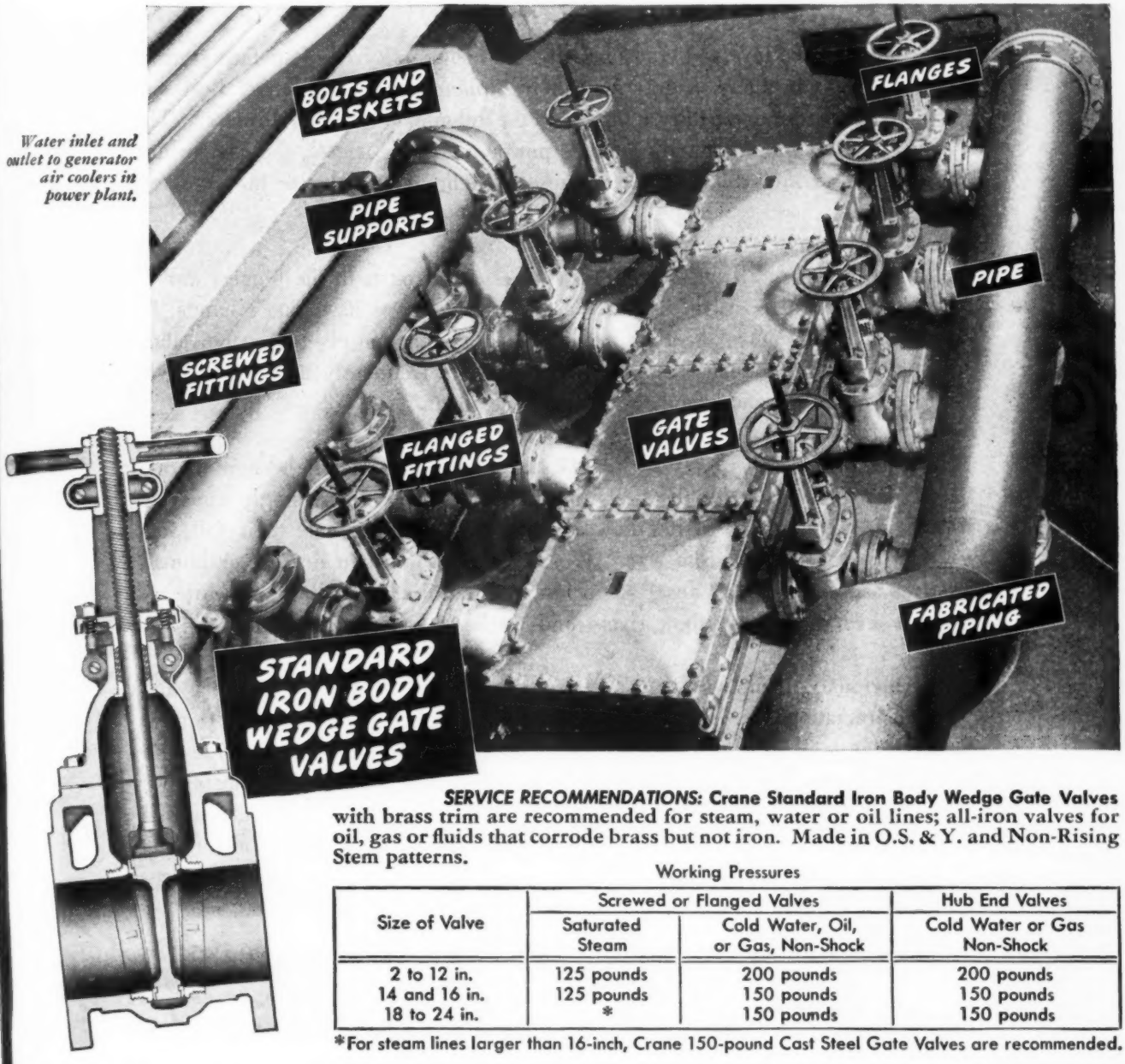
No matter what your need in piping materials... your Crane Branch or Wholesaler can meet it. One order covers all requirements at any time. You choose from the world's greatest line of piping materials—in brass, iron and steel. You help assure the best piping installation because all parts are of uniformly high quality—backed by a single responsibility. Not only do you simplify and speed deferred replacement work by using Crane *complete* piping materials service—but you get full benefit of Crane Co.'s 90-year experience in the piping equipment field.



Water inlet and outlet to generator air coolers in power plant.

SERVICE RECOMMENDATIONS: **Crane Standard Iron Body Wedge Gate Valves** with brass trim are recommended for steam, water or oil lines; all-iron valves for oil, gas or fluids that corrode brass but not iron. Made in O.S. & Y. and Non-Rising Stem patterns.

Working Pressures

Size of Valve	Screwed or Flanged Valves		Hub End Valves
	Saturated Steam	Cold Water, Oil, or Gas, Non-Shock	Cold Water or Gas Non-Shock
2 to 12 in.	125 pounds	200 pounds	200 pounds
14 and 16 in.	125 pounds	150 pounds	150 pounds
18 to 24 in.	*	150 pounds	150 pounds

*For steam lines larger than 16-inch, Crane 150-pound Cast Steel Gate Valves are recommended.

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VALVES • FITTINGS • PIPE
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War to End Wars . . .

Gatling, who invented the ancestor of modern rapid-fire guns, wrote: "It occurred to me that if I could invent a machine, a gun, which could by its rapidity of fire do as much battle duty as a hundred, it would to a large extent supersede the necessity of large armies, and consequently exposure to battle and disease would be greatly diminished."

Simon Lake invented his submarine for commerce free of surface storms; the Wright brothers didn't raise their biplane to be a bomber; Bell and Marconi had no military plans for the telephone or the wireless. The inventors of the automobile and its power plant, the diesel, the gas turbine and the steam turbine—none of these thought of any battles but commercial ones.

Yet, here are all these tools, playing essential parts in the biggest war in history—proof positive that once an invention leaves its maker's hands, he has no more control over its application than anyone else. Further, they are all living evidence that the needs of battle frequently act as incentives to development and adoption of advanced ideas.

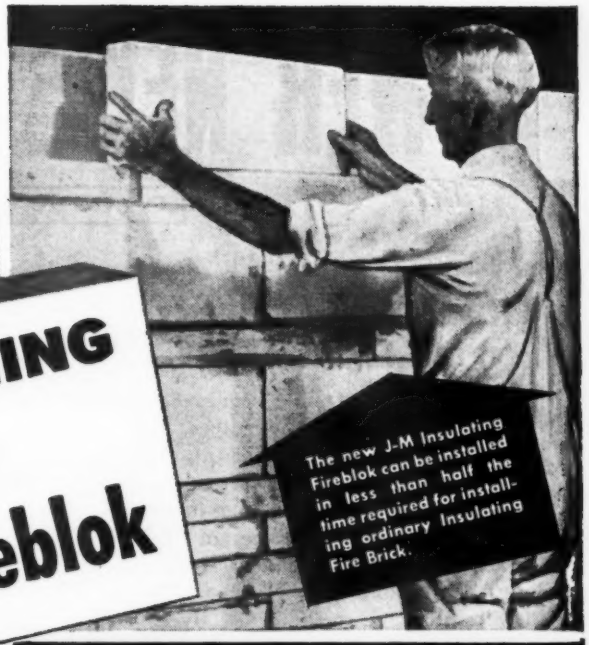
The animal law of survival of the fittest has in our hands become merely the law of survival of the best-outfitted. It becomes increasingly apparent that no weapons, no matter how appalling or indiscriminate their toll, can scare nations away from war. What's more, no cost in dollars or human lives can either—for Caesar spent less than a dollar to kill a man, while we have averaged many thousands—and we have killed more men.

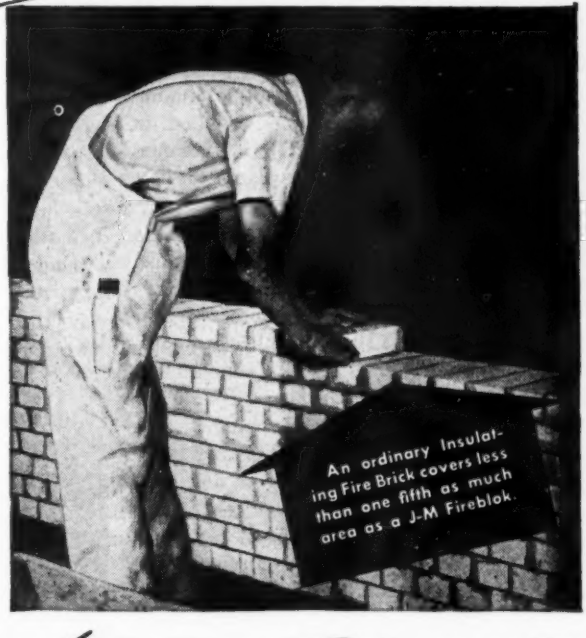
Obviously, then, no war can end wars. We must learn how to keep and to appreciate peace. We must seek out the real causes of conflict and remove them, as well as the apparent ones. We must control group pride and avarice—the ideological differences which are at the root of war as we know it today. If we succeed in eliminating these differences, we will remove with them the specious "lebensraum" and other economic arguments for war. We can take the profits from conflict—and apply them to peacetime stimulation of mechanical invention and economic evolution.

George Edwards
Engineer

LESS DOWN TIME

FOR FURNACE RELINING with big, new J-M Insulating Fireblok


The new J-M Insulating Fireblok can be installed in less than half the time required for installing ordinary Insulating Fire Brick.



ONE OF THE NEW LIGHTWEIGHT Johns-Manville Insulating Fireblok covers more surface than five Insulating Fire Brick. So, when you reline furnaces with it, you can often get the job finished several times faster. Consider how many hours this can save you in down time, in maintenance crew time . . . and how much faster your furnaces can get back into profitable production.

The larger, more convenient size is the only difference between J-M's four new Insulating Fireblok and the four well-known J-M Insulating Fire Brick. Either size of these four grades of highly efficient refractory linings for use from 1600° F. to 2600° F., has these important advantages:

Easy cutting and fitting—J-M Fireblok can be easily cut with a saw and shaped with a rasp. Most special shapes can be either shop or field cut from standard slabs, reducing the inventory of special shapes.

Minimum of joints—the large size, compared to the standard fire brick unit, materially reduces the number and length of joints, resulting in a thermally more efficient construction.

Economical bonding—with reduced joint length Fireblok requires a minimum of air-set cement for bonding. (J-M 1626 Cement was especially developed for this use.)

Uses—Fireblok can be used wherever Insulating Fire Brick are recommended such as for heat-treating furnaces, flues, stacks, mains and similar equipment. Also for the lining of doors, suspended arches, and, when tapered, for sprung arches of exceptional stability.

Write for new booklet, IN-103A, on this J-M development. Johns-Manville, 22 East 40th St., New York 16, New York.

MOST WIDELY USED BACK-UP INSULATION BETWEEN 600°F. and 1900°F.—J-M SUPEREX

Made of high-quality, calcined diatomaceous silica and bonded with asbestos fiber, Superex combines all the desirable qualities of these two insulating materials. Result: High heat resistance and exceptional insulating efficiency. Ideal for boiler walls, furnaces, etc. Available in 3", 6", 9" and 12" by 18" and 36" blocks. Other lengths to order. Various thicknesses.

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POWER NEWS

BUSINESS ITEMS AND APPOINTMENTS • WASHINGTON NOTES

CONVENTIONS • MODERNIZATION POINTERS • FUEL CONSERVATION

National Fuel Efficiency Program Fights Shortage

Launched more than a year ago in cooperation with Bureau of Mines, National Fuel Efficiency Program already has saved large quantities of fuel by eliminating waste and improving insulation and combustion efficiency of heating and power plants in industrial buildings. Responding to plea of War Mobilization Director James F Byrnes for assistance in averting a fuels shortage, NFEP has pledged that volunteer workers and 7500 large industrial fuel consumers will cut waste to a minimum. Coordinated program has resulted in savings of as much as 25% in fuel consumption in a number of plants.

Over-all goal this year is to save 29,000,000 tons of coal and proportionate amounts of oil, gas and other fuels. Technical facilities of Bureau of Mines are available through volunteer organization of about 10,000 combustion engineers, coordinators, etc, throughout the country. Bureau of Mines and National Fuel Efficiency Program appeal to fuel users who have not taken advantage of program's facilities to enroll now and help eliminate waste in generation, transmission and utilization of heat energy. Dr Sayers, bureau director, also announced appointment of several new coordinators, bringing total number up to 179 for the entire country.

Draft Status of Workers In Electric Utilities

Electric light and power utilities are classed as critical industries in a revised list of essential activities issued by War Manpower Commission. Under this classification, electric utilities will get more protection for draft-eligible workers between 26 and 30 years of age than will industries classed merely as essential. WMC's revision of essential activities list came as War Mobilization Director James F Byrnes ordered Selective Service to set up a priority system for induction of industrial workers between 26 and 30 in such a way as to minimize as much as possible the effect on essential activities.

Under withdrawal plan outlined by Byrnes, inductions of registrants 26 to 30 will be as follows: (1) Men not employed in industries designated as essential by WMC. (2) Men holding relatively unimportant jobs in industries designated essential but not critical and registrants who may be replaced without difficulty. (3) Registrants holding relatively unimportant jobs in critical industries and those replaceable without difficulty. (4) Registrants holding relatively more important jobs in essential activities. (5) Those holding more important jobs in critical industries.

Tree trimming for power lines was retained as an essential industry but was not classified as critical. In-plant maintenance and repair of industrial machinery was listed as critical, but repair of electric appliances and motors was listed as essential only.

Under plan outlined by Byrnes, tree trimmers would be called under the second step, but calls from electric utility organizations would come under steps three and five. All technical, scientific and research personnel engaged in any industry on the list, whether critical or only essential, are to be regarded as being engaged in critical activity.

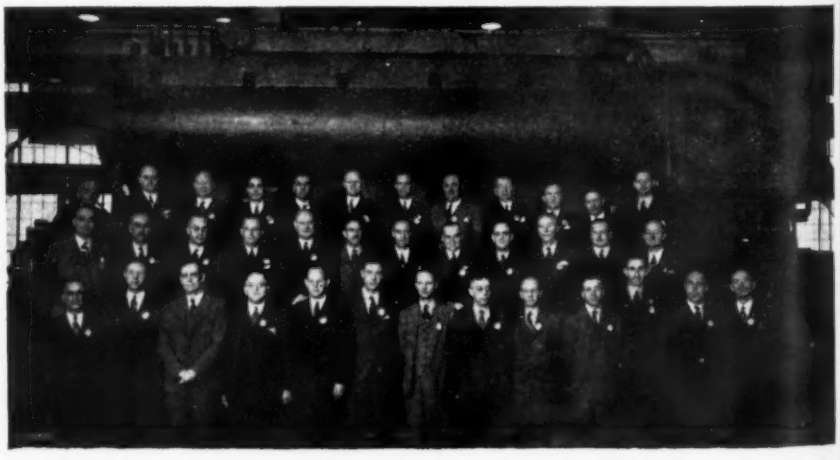
New Coal Orders Apply To Utility Power Plants

Solid Fuels Administration issued revisions of its Regulation 23 under which electric utilities' stockpiles supplied out of Eastern production districts will be pulled down substantially. No change was made in regulation's preference table where electric utilities rated behind byproduct users and gas plants but ahead of other industrial consumers.

Under one amendment, public utilities receiving coal by rail who buy in dis-

(*Continued on page* 180)

DIESEL BUILDER HOST TO EDUCATORS



Engineering educators and diesel men meet at Nordberg Mfg Co (story p 190). Bottom row, left to right: S E Winston, Illinois Inst of Technology; D L Arm, Iowa State; W D Bliss, J E Schoen, Marquette; B H Jennings, E F Obert, Northwestern; H L Solberg, Purdue; H O Croft, State U of Iowa; J P Connolly, J C Tollinger, S Dakota School of Mines; J C Miles, W N Espy, Illinois; B J Robertson, Minnesota. Second row: R W Bayerlein, Nordberg; L A Wilson, D W Nelson, Wisconsin; R R Tucker, Washington U; Harvey Hill, DEMA; R B Rice, N Carolina State; R E Friend, Nordberg; Henry Barbour, Clarence Benze, Fairbanks, Morse; H W Dow, J P Burls, Nordberg; L N Rowley, POWER. Top row: Jean Santschi, L L Peterson, J H Gallaway, John Friend, Emil Grieshaber, C E Stryker, H E Rogers, E H Hoeft, E C Bayerlein, D A Cheyette, H H Talboys, Robert Cramer, all of Nordberg. Completed marine engine in background

Jack, a former Nalco employee, now a Lieutenant (j. g.) in the U. S. Navy writes:

"You may be interested in knowing that water treatment has provided a brighter, or at least a cleaner, life for some 240 men aboard this ship. The sea water in our area of operation is pretty tough stuff . . . consequently our low pressure evaporator, which is used both for boiler make-up and ships use, was making about three-fifths of its rated capacity . . . this necessitated turning off the showers and basins to the crew, except for one or two hours of the 24. I managed to rig a corn starch and navy boiler compound treatment (only treatment available) and we are now making 10 percent over capacity and have the water on 24 hours a day, besides eliminating about 90 percent of the mechanical cleaning formerly necessary.

"It is hardly necessary to say that it does not compare with Nalco balls in quality or ease of handling. It is the same story which you have undoubtedly heard many a time, but it is darned nice to experience the benefits personally."

Yes, Jack—

NALCO SERVICE GETS THE JOB DONE BEST!"

. . . says H R Powers

Nalco Representative
Pittsburgh, Pa.

Photo in Nalco Laboratories

"You have seen it work many times Jack, ... how Nalco has licked the toughest kind of water treatment problem. And, today's power plant engineers, as they successfully combat scale, corrosion, pitting, foaming, algae, etc. in their plants, will back up your statement that it is *'darned nice to experience the benefits of Nalco! . . . .'*"

We are ready to prove what *Nalco—the complete water treating service*—can mean to you and your plant. Call Nalco today!

Nalco

No time to

Stop NEEDLESS Valve Casualties

Most valve trouble can be prevented before it starts... by frequent, thorough inspection... by repair or replacement of worn parts in time to prevent valves from destroying themselves. New maintenance workers should be taught to detect the first signs of trouble... to correct it without delay.

SEE THAT PIPING SUPERVISORS HAVE THIS VALUABLE HANDBOOK OF VALVE CONSERVATION

32 Pages... 80 Illustrations

The cause and cure of most common Valve Failures — from actual case records

Tells how to prevent needless deterioration and destruction, how to conserve hard-to-get equipment and avoid production slowdowns. Valuable information on valve selection installation, lubrication, packing, reseating – on pipe threading, gasket selection, etc. The only book of its kind ever offered. Write for your copy today.

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let VALVES "drop out of line!"

Keep your "veterans" in service --with regular inspection and care-- until replacements are certain

IT'S ANYBODY'S GUESS – when replacements will be normally available for valves in other than vital service . . . until Allied pressure pays off in final Victory – in the Pacific as well as in Europe.

BEST WAY to keep your present valves off the "casualty list" under the heavy burden of round-the-clock plant operation is to give them systematic attention and care.

PROPER CARE will keep valves in service now, and *after* V-day, when you'll need continued plant efficiency while plans for reconversion and reconstruction are carried out.

JENKINS ENGINEERS will help any management to prepare an effective program of valve conservation. You can get aid in solving unusual or tough problems merely by submitting full details to Jenkins Bros., 80 White St., New York 13, N. Y., Branches in Bridgeport; Atlanta; Boston; Phila.; Chicago. Jenkins Bros., Ltd., Montreal; London.

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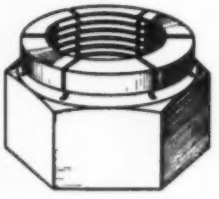
POWER'S DATA SHEETS

Number 151

Typical Locknuts

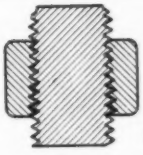


FLEXLOC

Segments press against bolt threads because inner diameter of upper part is slightly less than outside diameter of bolt

BOOTS

Threads of two sections are normally out of phase. Tightening sets up compressive force to provide holding

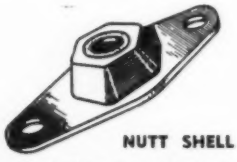


STOVER

Upper part of conventional nut is deformed to elliptical shape that provides spring grip against bolt threads

ESNA

Fiber collar grips bolt threads. Also available with metallic collar in place of fiber for high-temperature applications

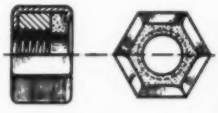


NUTT SHELL

Conventional nut pressed into light metal shell with fiber collar, which grips bolt threads

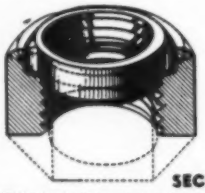
PALNUT TYPE 6 NAO

Top portion exerts spring pressure for added grip. No other nut is used with this type



FIBER

Fiber collar grips bolt threads

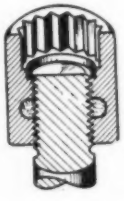


SECURITY

Elliptical alloy-steel retainer grips bolt threads

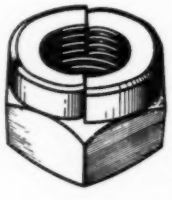
UNBRAKO

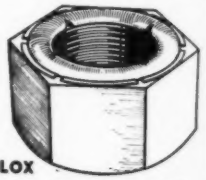
Fiber plugs pass through nut and press against threads of bolt



AEROTIGHT

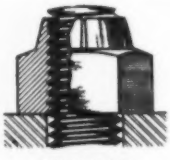
Upper part of nut is slotted and turned in to provide spring grip





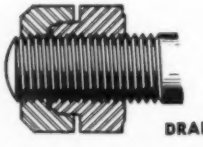
AN-COR-LOX

Soft metallic collar flattens against work, forcing edges into bolt thread



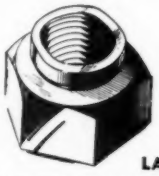
HUGLOCK

Upper threads press inward against bolt



DRAKE

Consists of two separate mating parts

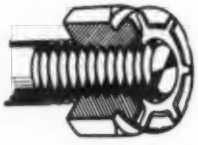


LAMSON

Raised crown is distorted and heat treated to give spring grip on bolt threads

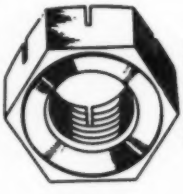
COLUMBIA

Upper part of two-section assembly wedges into lower part when tightened



PINNACLE

Metal diaphragm provides spring locking action

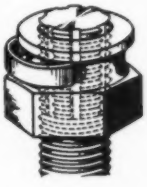


MARSDEN

Segments are forced inward against bolt threads when pressure is applied against recessed bearing surface

SEALTITE

Threads in section above slot are deformed to provide friction grip

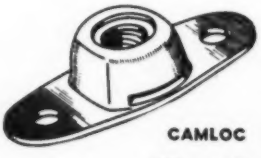


SIMLOK

Snap ring engages serrations in bolt thread to hold nut in place

Pin impinges against bolt to hold nut in place

ANCO



CAMLOC

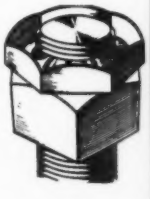
Fiber collar grips bolt thread

SELF-RETAINING

Threads in section above slot are deformed to provide friction grip

PALNUT

Single-thread lock nut applied and tightened after regular nut is in place



Adapted from *Product Engineering*

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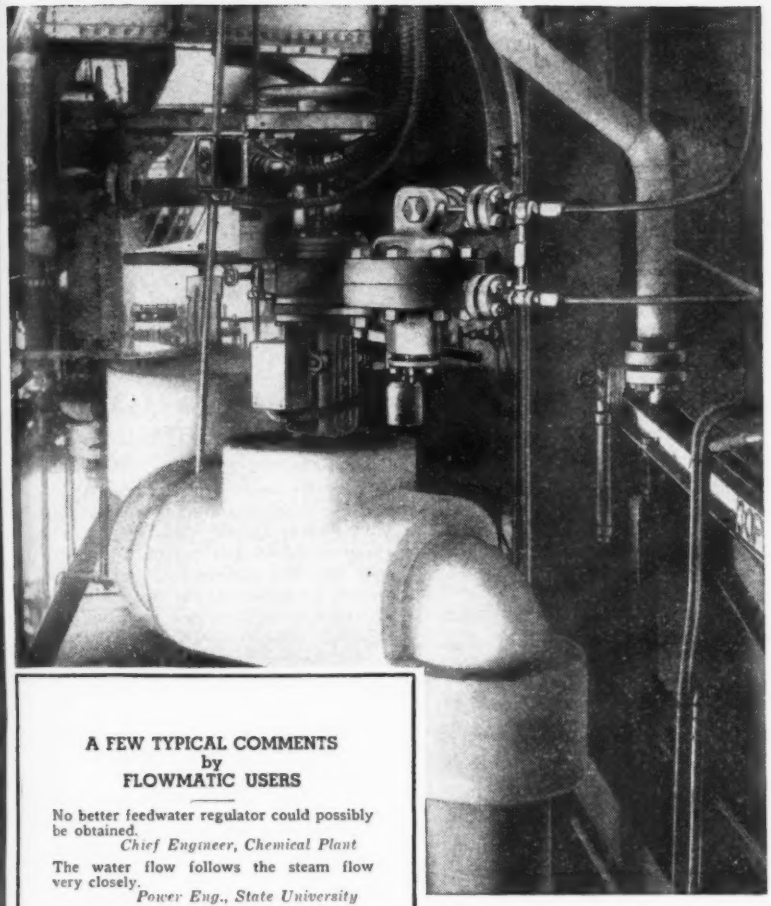
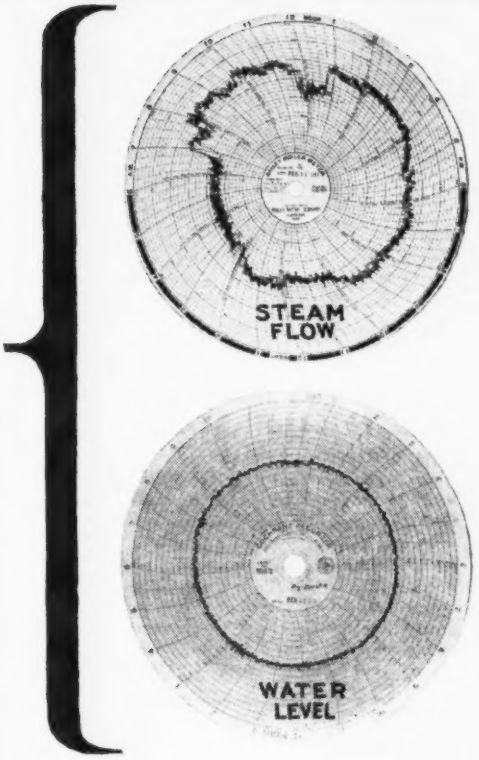
"FLOWMATIC *Protected*"





This 4" Copes Flowmatic in an Eastern Utility Plant safeguards feed water supply to a 675 psi 125,000 lb. per hour integral furnace boiler. With fluctuating loads and highly variable excess pressures, water level is held within ± 1".

A FEW TYPICAL COMMENTS by FLOWMATIC USERS

No better feedwater regulator could possibly be obtained.
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The water flow follows the steam flow very closely.
Power Eng., State University

No need to "baby" it—gives good results right from the start.
Chief Engineer, Central Station

Never saw any other equipment to compare with it—I like its simplicity.
Plant Engineer, Packing Plant

Without such instantaneous and accurate response of the feed water control valve to constantly changing load and level conditions, it would have been impossible to operate the plant at the high average efficiency of approximately 85 per cent.
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Operation very dependable.
Chief Engineer, Utility Co.

Very stable boiler water level with no more than routine care.
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No unit in our plant has operated with less attention.
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We are especially pleased with the ability of these regulators to function at extremely low loads.
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(Names on request)

HUNDREDS of Central Stations and Industrials with high-duty boilers appreciate what "Flowmatic Protected" means. They know that the Copes Flowmatic keeps feed input always in step with steam output to maintain water level within close, safe limits. They value its simple, sturdy design and independence of other automatics. They need not rely upon experts for installation, adjustment, or operation. To them, "Flowmatic Protected" signifies certainty of feed water control.

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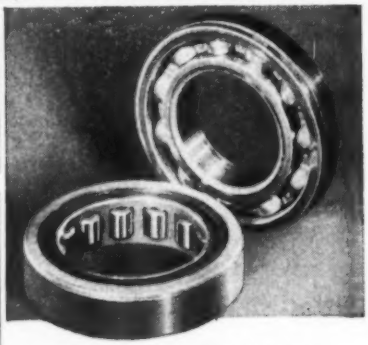

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Lubricants protect machine parts against the destructive action of rust and corrosion. This feature alone puts LUBRIPLATE far out in front of conventional lubricants.

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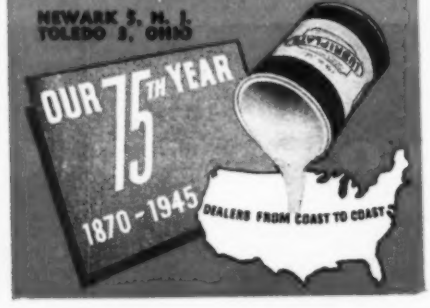

Centrifugal Pumps

(*Continued from page* 120)

ery, Fig. 13. Water slippage does not occur in this design as with an open or semi-open impeller but a running joint is needed between impeller and casing to separate the pump discharge and suction chambers. This running joint, generally formed by a relatively short cylindrical surface on the impeller shroud as at *A*, Fig. 13, rotates within a slightly larger stationary cylindrical surface *C* in the pump casing, Fig 2 and 7.

Q 17—*What is a straight-vane impeller?*

A—It is one in which the vane surfaces are generated by straight lines parallel to the axis of rotation. Vanes of this design are also called single-curvature vanes, Fig. 11 and 12.

Q 18—*What is a francis-vane impeller?*

A—Its vane surfaces have a double curvature and it is often called a francis screw-vane or screw-vane impeller, Fig. 14.

Q 19—*What is a mixed-flow impeller?*

A—An impeller in which the flow is both radial and axial. It is generally restricted to single-suction designs having a specific speed above 4200. Lower-specific-speed types are called francis screw-vane. Mixed-flow impellers having a small radial-flow component are generally classed as propellers. There are no standard rules to divide propeller, mixed-flow impellers and francis-screw-vane impellers.

Q 20—*What is an axial-flow or propeller impeller?*

A—An axial-flow or true propeller impeller is one having a flow solely parallel to the axis of rotation, in other words, strictly axial, Fig. 17.

Q 21—*What is a non-clogging impeller?*

A—For handling liquids containing rags, stringy materials and solids like sewage, conventional impellers with sharpedged vanes and restricted passages are not suitable because they clog. Designs with blunt-edged vanes and large water ways have been developed and are known as non-clogging impellers. For pumps up to 12- to 16-in. discharge, these impellers have only two vanes; larger sizes usually have three or four vanes.

Q 22—*What is an overhung impeller?*

A—If the impeller is supported by bearings on one side only and the shaft does not extend beyond the suction side

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LUBRIPLATE No. 205 is a lubricant developed for use in grease type anti-friction bearings operating at speeds from 5000 RPM to 20,000 RPM. Users of high speed machinery tell us that this remarkable lubricant often more than doubles the life of bearings. For the lubrication of anti-friction bearings with oil type housings LUBRIPLATE No. 1 or No. 2 is recommended depending upon the operating speed.

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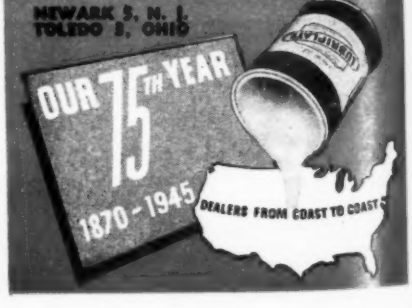

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of the impeller hub it is called an overhung impeller. This design makes possible the end suction pump, Fig. 15.

Q 23—*What is the suction eye of an impeller?*

A—The inlet just before the point where the vanes start is called the suction eye. In a closed impeller pump the suction-eye diameter is taken as the smallest diameter of the shroud, Fig. 18. When determining the suction-eye area deduct that occupied by the impeller hub.

Q 24—*What is the hub of the impeller?*

A—In a centrifugal-pump impeller it is the central part, Fig. 18, generally bored out for the pump shaft. It also frequently refers to the impeller part which rotates within the wearing ring when it is the outer impeller hub or wearing-ring hub of the shroud.

Q 25—*What is a solid casing and a split casing?*

A—Solid casing implies a design in which the discharge water passages leading to the discharge nozzle are all contained in one casing. To install or remove the impeller, at least one side must be open. Strictly speaking a solid casing cannot be used and casings normally called solid are radially split designs, Fig. 15. Split casing implies that the casing is made of two or more parts fastened together.

Q 26—*What is a horizontally split casing?*

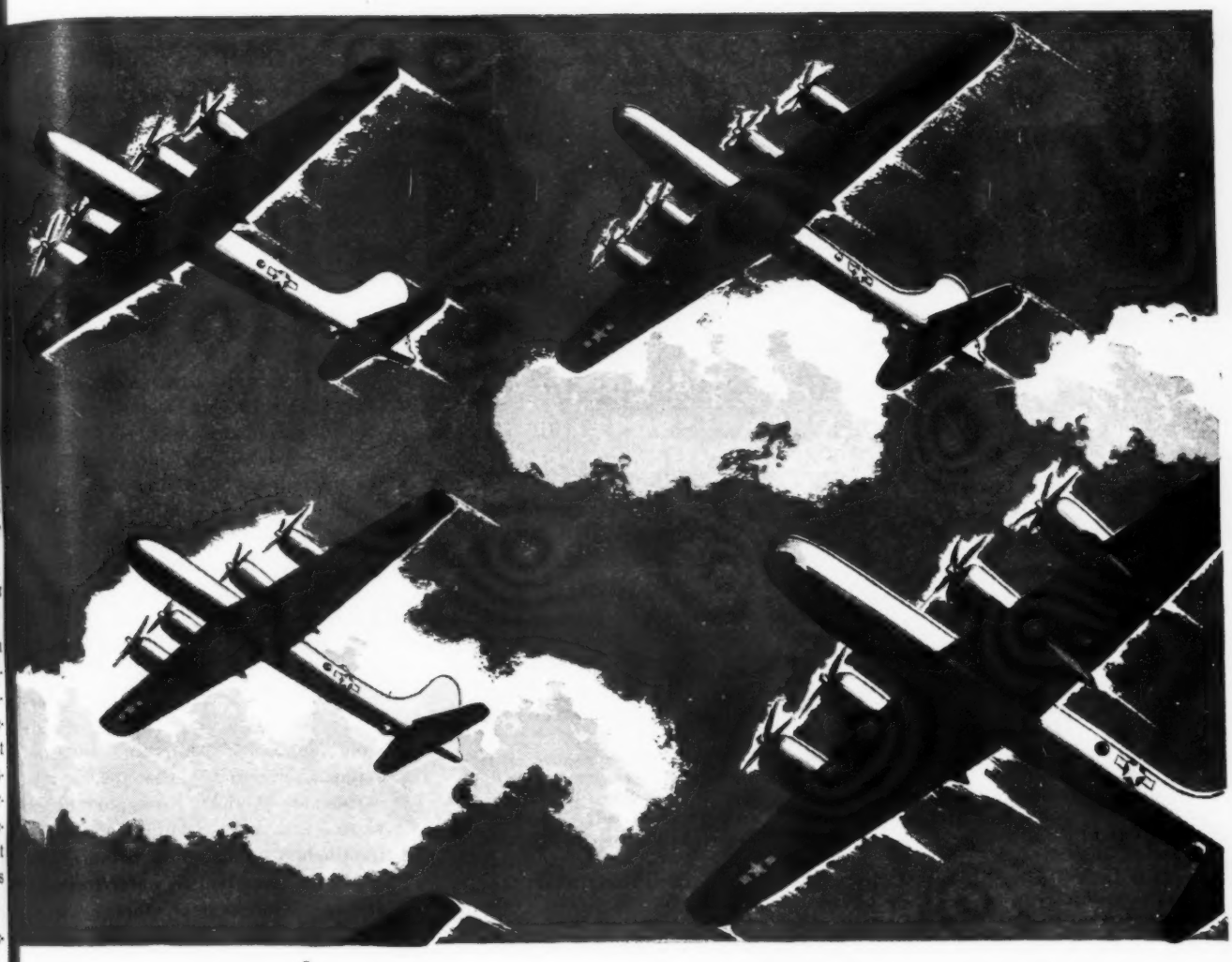
A—This term indicates a casing construction divided by a horizontal plane through the shaft centerline, Fig. 19. This designation is not entirely satisfactory and many design engineers prefer the term "axially split" casing. As both suction and discharge nozzles are normally in the lower half, this construction permits removal of the casing top half to inspect the pump's interior without disturbing the bearings or piping.

Q 27—*What is a vertically split casing?*

A—Like horizontally split, vertically split is bad terminology. It is intended to refer to a casing split in a plane perpendicular to the axis of rotation, Fig. 15. The term "radially split" is now used by some designers to designate this type construction.

Q 28—*What is a diagonally split casing?*

A—A horizontal-shaft pump with a casing split along a plane passing through its axis but inclined diagonally from the horizontal, Fig. 20. This construction, used primarily where vertical discharge is necessary, permits convenient opening of the casing for internal inspection of the pump.



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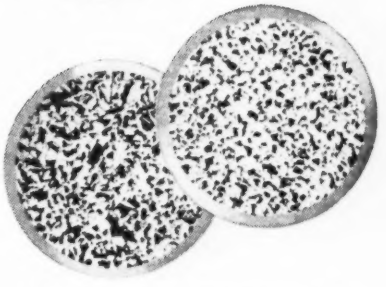

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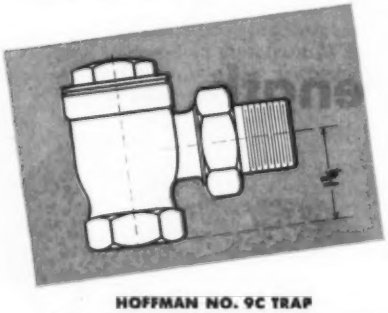

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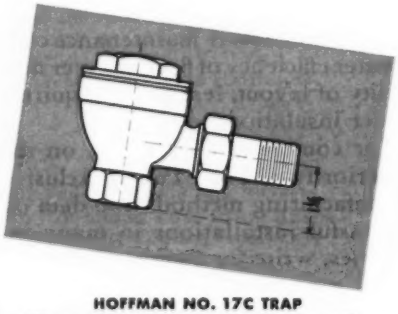

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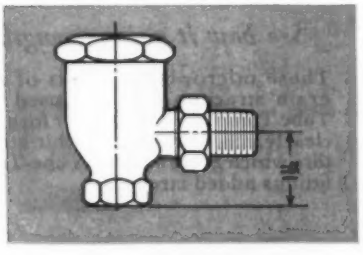

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Reader's Problems

(*Continued from page* 113)

itself. This is caused by temperature gradients existing within the frozen block and difference between expansion of the frozen block and metal walls of the freezing cans.

Presence of bicarbonates in the water may also cause cracking. The bicarbonate ion causes internal stresses to be set up during the freezing process similar to shrinking strains in cast iron. Should carbonates be present, injecting gaseous carbon dioxide would form bicarbonates. This reaction is reversible and the solubility of carbon dioxide in such a solution depends on (1) ratio of carbonates to bicarbonates (2) total amount of sodium carbonate and bicarbonate salts present in the solution (3) pressure of the carbon dioxide gas in the system.

Ice made from distilled water shows less tendency to crack than that made from solutions containing dissolved salts. Converting carbonates and bicarbonates to their corresponding sulphates with alum is often an effective treatment. Ammonium alum, when used as a coagulant in water treatment, affects the mechanical properties of ice produced from the treated solution. Introducing ammonium salts increases the solubility of calcium and magnesium carbonates and calcium sulphate and prevents precipitation of insoluble material within the ice. This condition causes cracking.

Salts in the water, bulged ice cans, uneven brine circulation, brine temperature too low, insufficient length of tempering time, too warm or too cold dip water, and tank-room air too warm —all have been accused of causing cracked ice.

At brine temperatures below 15 F. actual experience of ice-plant operators regarding water for making ice is:

1. Solutions containing soluble carbonates produce cracked ice.
2. Solutions softened with lime to such a degree that the treated water is alkaline produce cracked ice, whereas unsoftened water is unlikely to do so.
3. In many instances adding alum, usually ammonium alum, increases the ice-cracking tendency.
4. Adding sodium aluminate frequently causes cracking.
5. Adding ammonium chloride reduces the ice-cracking tendency.
6. Cracking tendency is reduced by neutralizing lime-treated waters, wherein existing carbonates and bicarbonates are converted to sulphates by adding proper amounts of aluminum sulphate.

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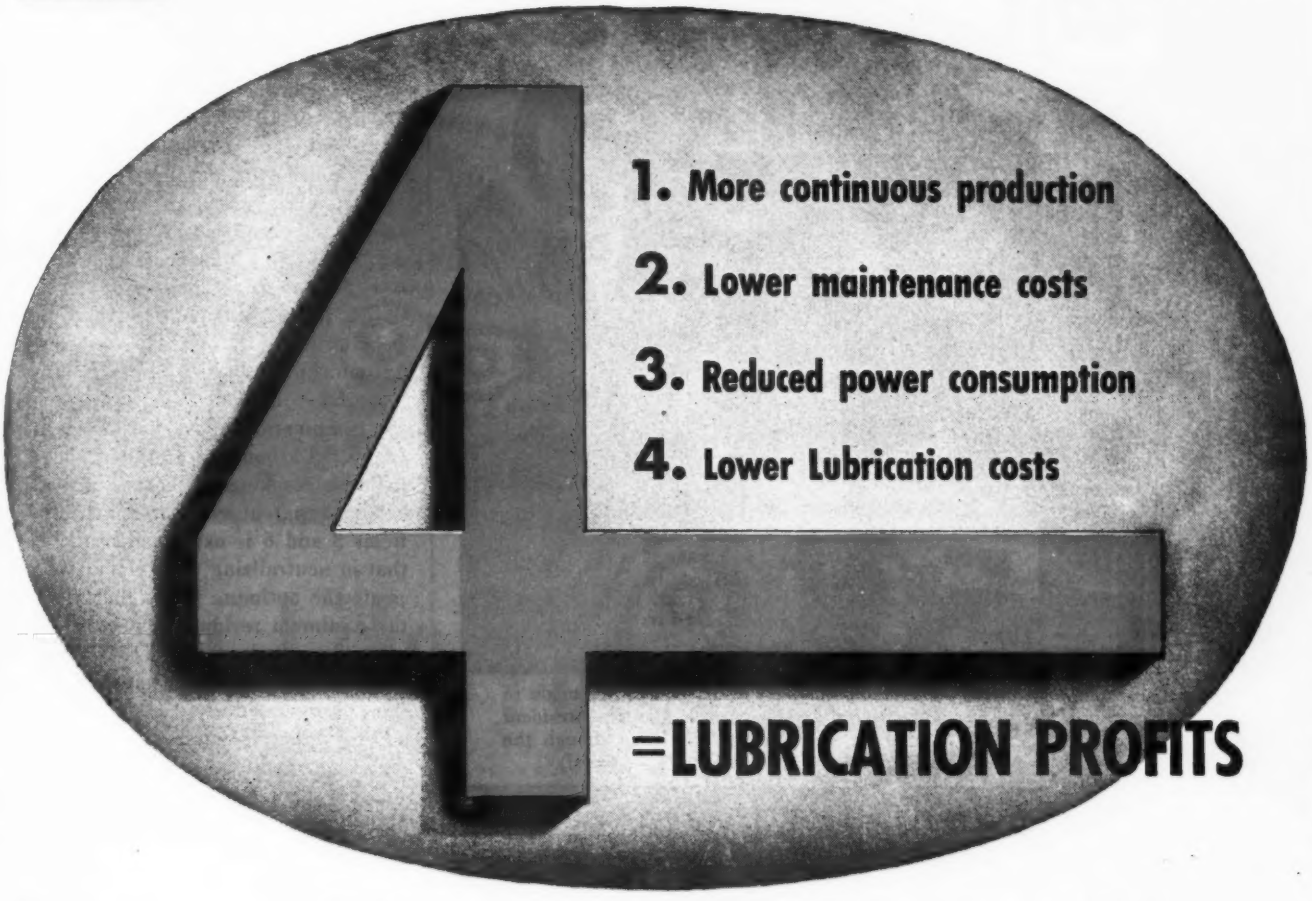

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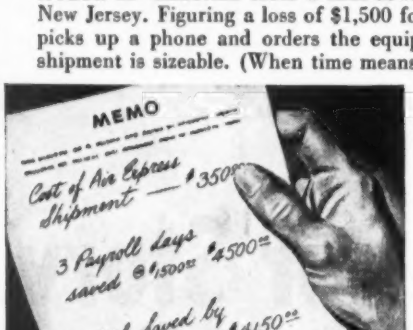

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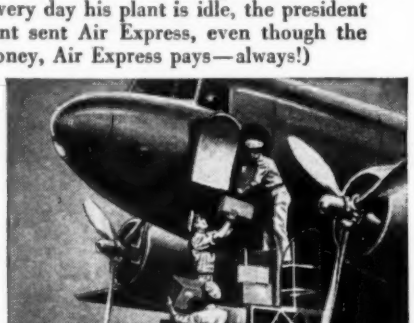

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plain the cause of cracking none of them is generally amenable to results obtained in practice. However, a distinct correlation apparently exists between pH of the water being frozen and its cracking tendency. A tentative relation exists between the range of pH, wherein the cracking tendency is reduced to a minimum, and the brine temperature.

At a brine temperature of 16 F the zone wherein cracking tendency is a minimum extends from a pH of 5.5 to 8.5, while with a brine temperature of 6 F the range narrows down to a pH of 7.0, plus or minus 0.1 or 0.2. Water peculiar to each locality possesses an optimum pH at which it can be frozen with least difficulty, depending upon the combination of its dissolved constituents. Carbonates and bicarbonates increase cracking by influencing pH.

The apparent contradiction between items 3 and 6 is explained by the fact that in neutralizing with aluminum sulphate the optimum pH is that yielding the minimum residual concentration of aluminum hydroxide. This optimum pH is 6.4 to 6.5. In treatments where the cracking tendency is increased by adding alum, it can be definitely said that overtreatment resulted in a considerably lower residual pH than the optimum value for that brine temperature.

Since sodium aluminate hydrolyzes strongly alkaline, cracking, as a result of its use in treating the water, may be attributed to a relatively high pH. Any beneficial effect exerted by the presence of ammonium chloride may result from neutralization produced by hydrolysis of the salt. There is considerable doubt that its effectiveness is a result of an increased solubility afforded relatively insoluble compounds in the treated water.

Therefore the effect of carbon dioxide on the dissolved constituents in the water is to increase the cracking tendency. The fact that distilled water exhibits a low cracking tendency when frozen is indicative of the resultant detrimental effect of any dissolved gas in the water to be frozen. Absence of dissolved oxygen and carbon dioxide is insured in freshly distilled water that has not been exposed to the atmosphere for any great length of time.

Increasing the brine temperature above 16 F would, of course, reduce the cracking tendency at the expense of output per unit of time. It may be possible to reach an optimum rate of ice production with a minimum of loss from cracking by correlating brine temperature and net yield. This would

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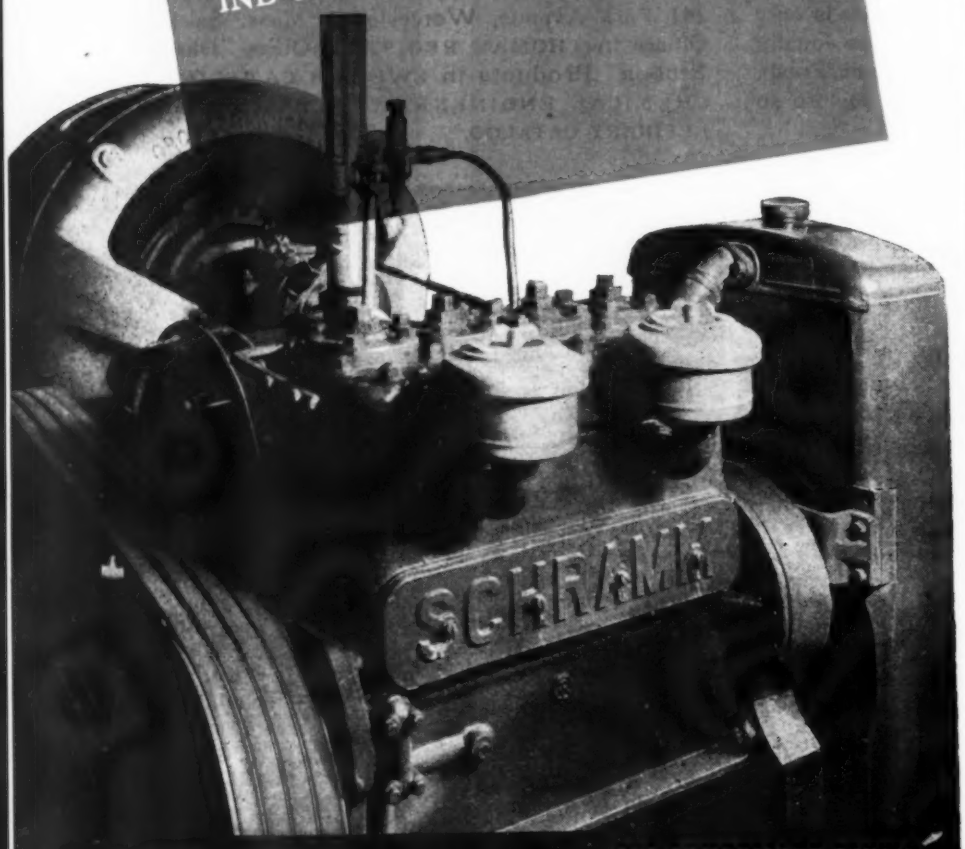
Schramm Air Compressors are specified by power plants because they do a *variety* of jobs . . . give you all the air you want . . . and are economical to run.

Note these uses to which Schramm is used to furnish air: operating milling and drilling machines; chipping and calking hammers; cleaning engines and generators; sand blasting; cleaning boiler flues; and every other pneumatic tool requirement.

Schramm compressors are lightweight, 100 per cent water cooled, and compact. For full descriptive data, write today for Bulletin IND-44.



SCHRAMM INC.
THE COMPRESSOR PEOPLE
WEST CHESTER
PENNSYLVANIA

be a last resort if water treatment prior to freezing should bring poor results.

Solubility of a gas in a solution is directly proportional to its concentration in the space above the liquid, and inversely proportional to the solution temperature. For this reason the solubility of carbon dioxide in water is small at the water temperatures and gas pressures encountered in an ice plant. There is not the remotest chance of keeping the original quantity of gas dissolved once the injection tube has been removed from the water.

Although water temperature drops as freezing progresses, the concentration of dissolved gas would be extremely small and it would tend to leave the solution faster than the lowering water temperature could induce absorption. Turbulence of air injection during freezing certainly would aid the escape.

The presence of carbon dioxide in boiler feedwater accelerates corrosion, but the temperatures experienced here are far above those encountered in an ice plant. It is well known that corrosion increases with temperature, so that practically none can be expected at the low temperatures met in ice manufacturing.

In some ice plants carbon dioxide is fed into the brine to reduce the free alkalinity and produce a pH under 8.0 to form a tough, adherent film on the outside of the ice cans. This coating consists of a basic carbonate of zinc which indicates a satisfactory brine condition and gives maximum protection to the galvanized surface.

J D CONSTANCE
Cliffside Park, N. J.

Keep the Water Agitated

SOMETIMES ICE CRACKS as soon as a can is lifted from the brine. This may occur when the tank temperature is too low and the atmosphere too warm. Generally this cracking occurs at only one spot in the tank. Here poor brine circulation is to blame.

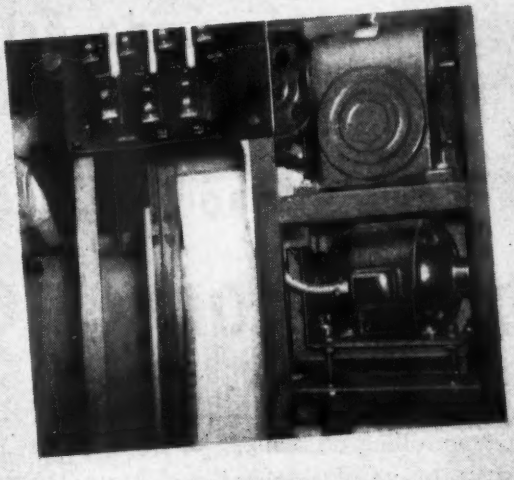
In our plant cracking was so bad in one spot in the tank that about twelve blocks always fell to pieces when dumped. When brine circulation was corrected by installing a wooden partition, the trouble stopped. Watch the time in which different parts of the tank freeze solid and if possible change the circulation so as to have uniform freezing.

Clear ice can be made from raw water provided the latter is kept in motion during freezing. We use com-

IN STUFFY SPOTS

Many a motor must be located where walls, adjacent equipment, or materials cut down the free flow of air. Sometimes, as in the case of this wool-dryer drive, surroundings are hot, and stuffy, too.

Tri-Clad motors have proved themselves cool-running even under such conditions. Their powerful, double-end ventilating system moves the air at controlled velocity for effective heat removal. The location and baffling of dual exhaust ports discourage recirculation.



Tri-Clad motor drives conveyor on wool dryer—Bigelow Sanford Carpet Co., Amsterdam, N. Y.

AIR-FLOW TESTS OF TRI CLAD MOTORS LEAD TO PROTECTION FROM OVERHEATING

Plenum chamber test of Tri-Clad motor ventilation at G-E motor factory.

Before new types or sizes of Tri-Clad motors are approved for production, plenum chamber tests are conducted on the ventilating systems of sample models. These measurements serve as a check on previous calculations of the volume and velocity of air through the motor under different conditions. Other tests under load within enclosures and at abnormal ambient temperatures are also made. If your motors must be confined in stuffy spots, G.E. can help you make the right choice to beat the heat. *General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

750-255-8030

Buy all the BONDS you can—*and keep all you buy*

boiler room foreman grins as he says "goodbye" to

OXYGEN CORROSION

"Easy as rolling off a log," he says, "when you use Santosite. And it works like a charm. No more oxygen corrosion in *our* boiler from here on in!"

And that's a fact. Only *30* parts of Santosite (Sodium Sulphite Anhydrous, Technical) per *million* parts of water in the boiler is all it takes. Easy to use. Costs little, and it *will not discolor the water*, or cause foaming.

So if you want a simple, inexpensive insurance against oxygen corrosion, start using Santosite right away. It means fewer shutdowns — fewer repairs — greater all-round boiler efficiency.

Santosite is available right now.

Get in touch with the nearest Monsanto office or write to: MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 South Second St., St. Louis 4, Missouri. District Offices: New York, Chicago, Boston, Detroit, Charlotte, Birmingham, Los Angeles, San Francisco, Seattle, Montreal, Toronto.

MONSANTO CHEMICALS

SERVING INDUSTRY...WHICH SERVES MANKIND

pressed air to agitate the water fully.

The main air pipe is fitted with a number of crosses corresponding to the rows of cans, each cross being fitted with a valve and nipple. To the nipples are attached short pieces of hose fitted with a pipe that is put through a hole in the can cover and into the water. When freezing progresses and ice approaches the pipe, the latter is removed and a shorter piece inserted.

In this way air agitation is continued until freezing process is completed. Hose and nipple are removed a short time before the entire mass is frozen. We use about 1 cfm at 3-psi pressure per ton of ice.

Oaklyn, N. J. C A WILKES

Stresses Cause Cracking

ICE CRACKS mainly for two reasons: (1) freezing stresses set up by expansion and contraction of the water and ice while freezing (2) presence of bicarbonates in the water. When water high in bicarbonates freezes, the half-bound carbon dioxide comes out of solution and as the ice crystallizes the entrapped gas remains in the cake filling it with infinitesimal gas pockets which give the ice an unsound physical structure readily susceptible to breakage. I do not recommend CO_2 as it rapidly increases the tendency of ice to crack.

Water containing sufficient CO_2 to reduce the pH substantially below the neutral point of 7.0 is exceedingly corrosive to ferrous piping and equipment coming in contact with it. It takes very little CO_2 to give water a pH below 7.0.

I suggest that the water be analyzed completely, but particularly with respect to bicarbonate content. It is possible that the water used for ice is entirely responsible for the cracking difficulties experienced.

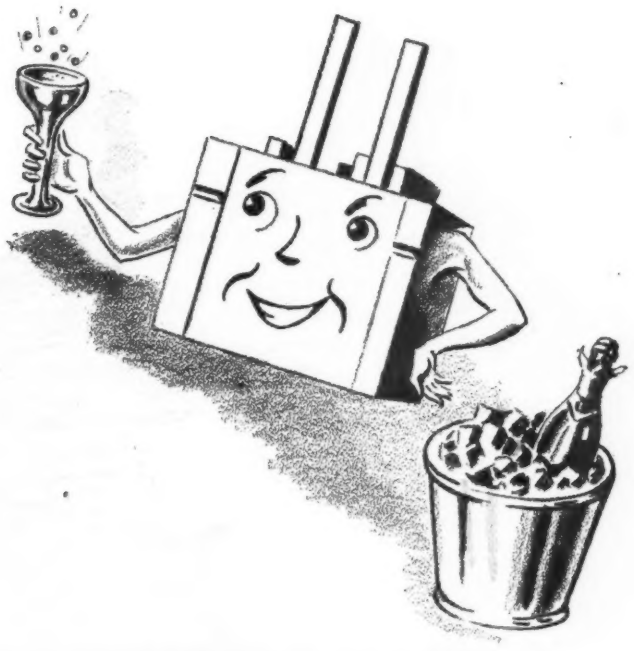
Clayton, N. J. S F ALLING

Amines Check Corrosion

(*Continued from page* 73)

tration was highest, about 2 ppm, when condensate returns had an average pH of 9.0 and an average amine content of 160 ppm. In contrast, samples of condensed vapor from the deaerating-heater vent contained as much as 830 ppm of amine and total CO_2 of 700 ppm.

These tests show that batch feed



DOES YOUR PLANT

have a champagne taste when it comes to coal?

Why

FAIRMONT LOW FUSION COAL?

because!

. . . it can be burned efficiently and economically in any combustion equipment properly engineered for its use.

. . . it will be available for many years to come because of its huge reserves.

. . . it has an attractive B.T.U. value when compared with that of high-priced, limited-supply premium coals.

. . . it assures competitive steam costs because of long range planning.

Modernize your plant with equipment liberally designed to burn a wide range of coals and you eliminate the necessity for high-priced coals to satisfy that "champagne taste". Include low fusion coals in design specifications and you can utilize, with equal efficiency, a variety of coals.

FAIRMONT COAL is consistently economical for steam generation because of its lower mining cost and tremendous reserves. The investment for modernization will pay dividends promptly and will assure competitive steam costs during the entire life of the plant.

Every plant can and should have a *beer pocketbook* when it comes to steam costs. Ask us to be specific.

The Fairmont Coal Bureau has some very interesting and timely data (most of which are available for the first time) to send you on the subject of coal and its relation to equipment and power costs. These data are in "Reference Bulletin" form and will be sent promptly on request. If you'll mail coupon below we'll have an opportunity to present this important information which you should have immediately.

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P. 3-45

HONAN-CRANE
Oil Purification Engineers

. . . have the advantage of outstanding research and engineering facilities.

Honan-Crane maintains a complete research laboratory at Lebanon, Indiana and employs the services of national research institutes. Constant research is devoted to the important problems of acidity control, sludging tendencies, corrosion, detergent oils and many other lubrication problems. Honan-Crane Engineers are equipped with the results of this important work.

These men also have the counsel and advice of outstanding authorities in the field of oil purification. Paul Honan, with more than 25 years of experience in engineering and building oil purification equipment; A. S. Harlan, chief engineer, and Ben Hunter, lately of Gulf Oil Corporation, one of the world's foremost authorities on lubrication of modern engines and machines.

On problems of oil purification Honan-Crane Engineers can give you intelligent advice. Write today. A Honan-Crane Engineer will call at your convenience.

HONAN-CRANE CORPORATION
Subsidiary of Houdaille-Hershey Corporation
1200 SIXTH STREET
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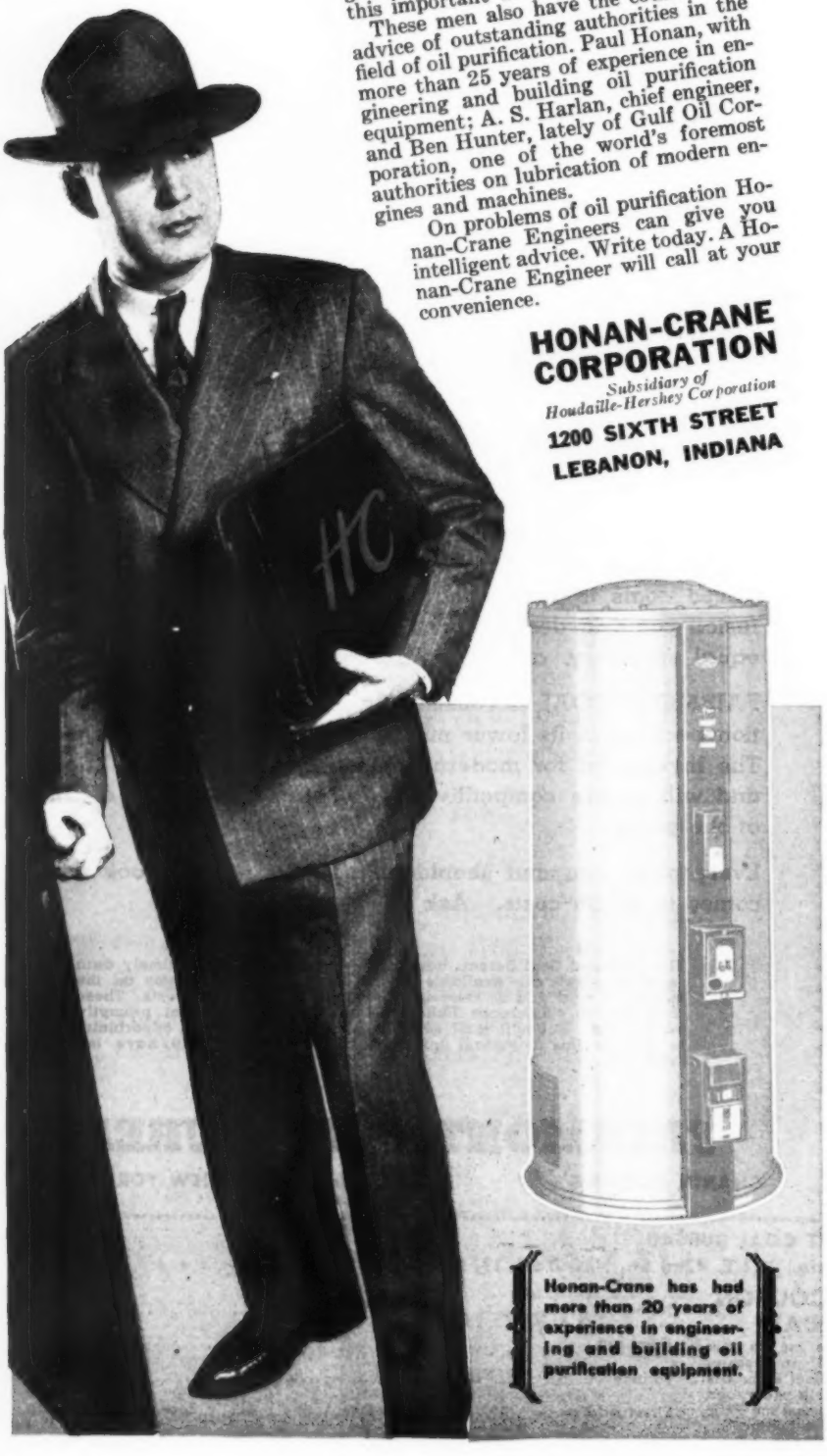

Honan-Crane has had more than 20 years of experience in engineering and building oil purification equipment.

creates high concentrations in the steam system momentarily but does not continuously provide for an alkaline condensate in traps and radiators. Inasmuch as corrosion is generally most severe adjacent to these units, it is desirable to feed the treatment continuously. According to present data, periodic high concentrations have no special usefulness in preventing corrosion other than to decrease the time that the steam is acidic.

Cyclohexylamine bicarbonate is formed in the condensate from a relatively weak base and weak acid. Volatilization of either the amine or CO_2, or both, tends to cause complete decomposition. The amine appears to be more volatile than CO_2 when contained in alkaline water entering the deaerating heater. Increasing heater temperature from 210 to 220 F does not appear to greatly affect amine volatility, but does drive off considerably more CO_2. Maintaining high feedwater-heater temperature increases the relatively high amine loss slightly, but the amount to add decreases considerably because less CO_2 contaminates the steam.

No ammonia was found in the steam or in the return condensate. Cyclohexylamine can therefore be used without breakdown in a steam system operated at 100 psi. and is probably stable at considerably higher pressures.

Argument Corner

(*Continued from page* 124)

it took several minutes to get together again. Fortunately the diesels took the overload so there was no interruption to service.

As the average operator is more concerned with the load on the prime mover than he is with the protective devices on the system, this brings to his attention the relation of line amperes to actual load or kw.

Rushville, Ind. G D NOILES

Credit for Boiler, Waterwall Designs

LATELY I have noticed articles appearing in your magazine that leave the impression that Day and Zimmerman. Inc, were the designers and builders of the boilers and waterwalls described in the various articles.

This is not true, as Day and Zimmerman and John Phillips Baden-

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Rockford,

January 3, 1945

Benjamin F. Shaw Company
2nd & Lombard Streets
Wilmington, Delaware

Respected Friends:

At this time, at the close of another difficult war year we want to convey to you our gratefulness for the cooperation you have given us during the past twelve months.

The demands of our armed forces have continued to have first call on our equipment with the result that our ability to adequately service civilian business has been greatly handicapped and unavoidable delays caused.

Your understanding of our situation and your generous spirit of helpfulness have been of immeasurable assistance during this critical period.

We look forward to a continuation of the same close relationship that we have enjoyed with you for many years. With best wishes to you and your associates, we remain

Respectfully your friends,
JOSEPH BANCROFT & SONS CO.

W. R. MacIntyre

W. R. MacIntyre, Vice-President

SOCIATION OF FINISHERS OF TEXTILE FABRICS

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SHAW Pre-Fabricated Piping

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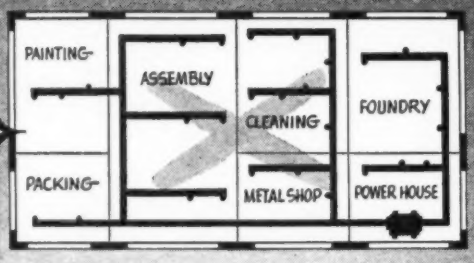
Second & Lombard Sts., Wilmington 99, Del.

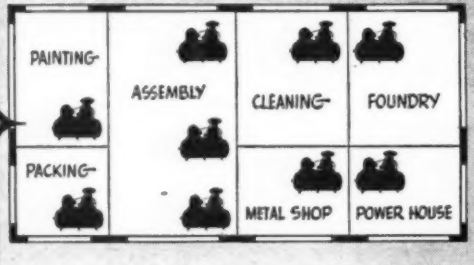
Kellogg-American "On the Spot" AIR

New Industrial Air System of Greater Efficiency . . .

OLD WASTEFUL METHOD . . . long pipelines carry air to all departments from one large compressor. Every air outlet and pipe joint is a possible point of leakage. Resultant air losses can slow down production, may double the cost of maintaining working air pressure. If a large compressor should fail, the whole plant may shut down.



NEW EFFICIENT METHOD ...smaller capacity KELLOGG-AMERICAN air compressors are located in each department right on the spot of usage. Costly air losses due to long pipelines are eliminated. Working air pressures are maintained, thus assuring efficiency and economy in every department.



Adequate air volume at the right pressure. Wherever, whenever you need it. *Without noise* and *vibration.* That is KELLOGG-AMERICAN "On-the-Spot" air. For whisper-quietness and vibration-free operation are built into KELLOGG-AMERICAN air compressors. Compression efficiency is high. Operating and maintenance costs are low. Chances are, your present pipeline losses will more than pay for efficient KELLOGG-AMERICAN "On-the-Spot" air. Consult your nearest Kellogg-American Distributor or write direct for further information.

KELLOGG DIVISION
ROCHESTER 9, N. Y.
AIR COMPRESSORS · PAINT SPRAY EQUIPMENT

AMERICAN Brake Shoe COMPANY

hausen in jointure performed all the work, in which all the engineering was done by and under the supervision of John Phillips Badenhausen, and Day and Zimmerman, Inc, furnished the money.

Lack of pointing this out in these articles is not fair to me and I wish you would publish this letter to set the matter straight.

Philadelphia, Pa.

JOHN PHILLIPS BADENHAUSEN

Editor's Note: Mr. Badenhausen refers to the article "Waterwalls Double Old Boilers' Output," August, 1944, p 85-87. The article, which was written by Lloyd J Westin, of Day and Zimmerman, and approved by that company, included the following credit line: "*The scheme finally worked out by the engineering staffs of Rainey-Wood Coke Co, I W Wolfgram, supt; Philadelphia Coke Co, A C Sedlacheck, supt; and Day and Zimmerman, Inc, Philadelphia, under the direction of John Phillips Badenhausen, added steaming capacity. . . .*"

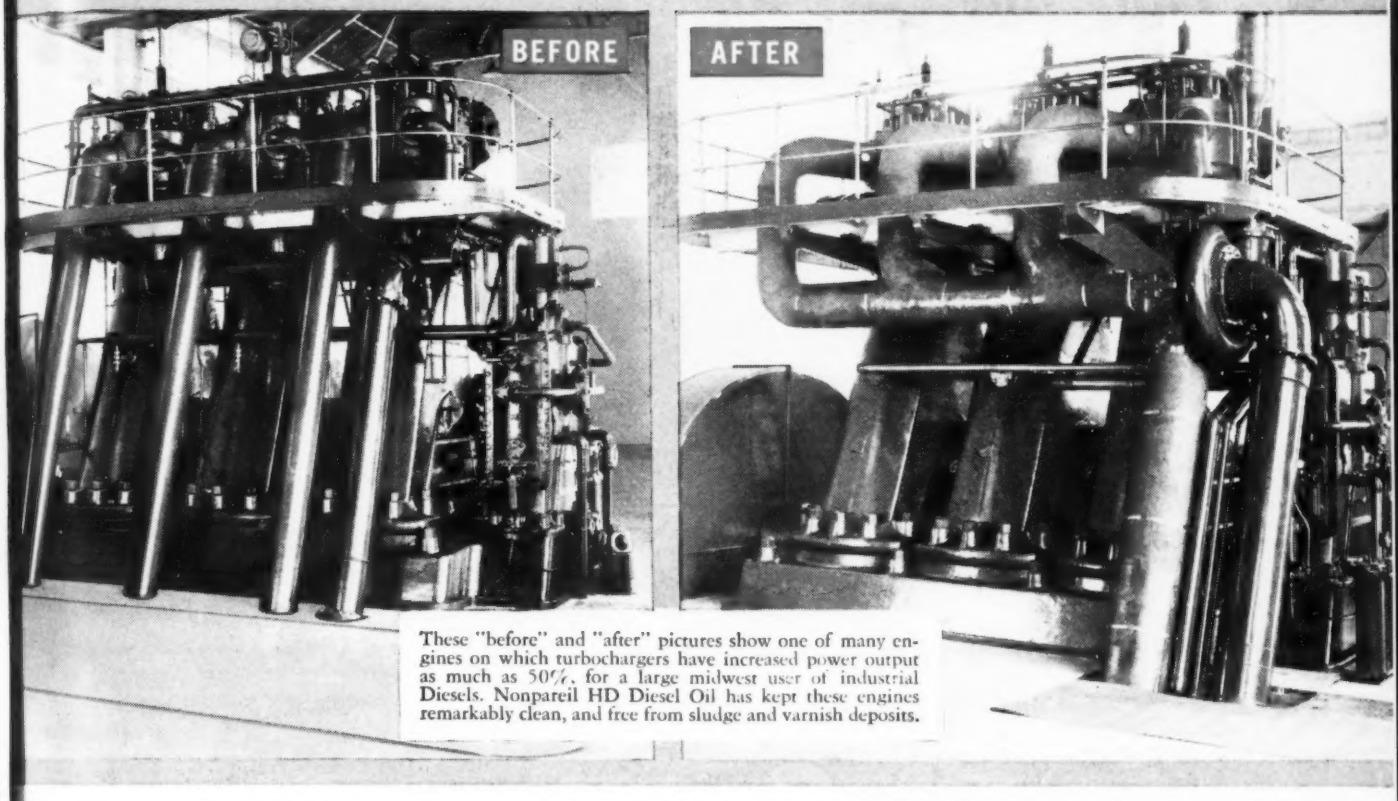
Graphic Ammeter Checks Motor Current

DETAILS in Reader's Problem No. 1, Dec, 1944, are actually too meager to permit other than generalizations. To begin with, how long has the equipment been in service and how recently has the difficulty been indicated? What type of prime movers drive the generators? Are they steam or diesel? Does the governing equipment maintain uniform speed, or is there a tendency toward a relatively marked increase at lighter loads? Are the capacitors in satisfactory operating condition? The capacitor current rating indicates they are of approximately 660 v, which makes necessary connection to the 2300-v circuit through a transformer. Is the voltage-regulating equipment kept in good condition and does it function properly?

The periodic current increase might indicate a particular generating condition at low load which tends to make the voltage wave more peaked as a result of partial resonance in the motor-capacitor-transformer group. Since no connection diagram is submitted, comment on this detail is impossible.

Assuming full load current at 5.3 amp, an overcurrent setting of 6.3 amp or even higher would not be excessive because 5.3 amp at 100% pf indicates a motor current without capacitor of approximately 6.7 amp. A graphic ammeter connected in the motor circuit

ncreased Diesel output with turbochargers...



These "before" and "after" pictures show one of many engines on which turbochargers have increased power output as much as 50%, for a large midwest user of industrial Diesels. Nonpareil HD Diesel Oil has kept these engines remarkably clean, and free from sludge and varnish deposits.

...cut lubricating troubles with

NONPAREIL HD DIESEL OIL

CAUGHT BETWEEN the increased demands for power and the scarcity of new Diesel equipment, a midwestern industry turned to turbochargers. The results were highly pleasing. Some engines were increased from 500 horsepower to over 900 horsepower by increasing speed, converting to solid injection, and adding turbochargers. As much as 50% increase in output was obtained by supercharging alone.

Even before these engines were supercharged, however, higher loads and longer hours of operation had increased lubricating troubles. With the change-over, Nonpareil HD (a heavy-duty, detergent oil) was tried. Today the master mechanic reports not only a much higher output from the 12 supercharged engines, but he states: "Nonpareil HD has resulted in better lubrication than we have ever obtained." A further report states: "Nonpareil HD has resulted in unprecedented freedom from stuck rings... and crankcase cleanliness that has previously been impossible."

Nonpareil HD has proved, on these and other hard-to-lubricate Diesels, that it will help eliminate the most stubborn and troublesome deposits in Diesel engines.

Nonpareil Diesel Oil is made in HD (heavy-duty, detergent) and regular types. You can get an unbiased recommendation from a Standard Oil Lubrication Engineer as to which you need for your type of service. Write Standard Oil Company (Indiana) office, 910 South Michigan Avenue, Chicago 80, Illinois, for the Engineer nearest you.

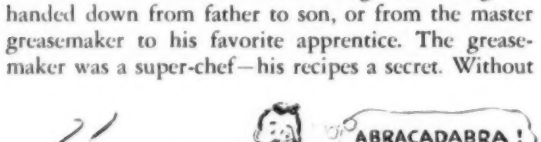
Buy more War Bonds

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

★ LUBRICATION ENGINEERING

The ~~"art"~~ *Science* of greasemaking—and you, the "user"

NOT MANY YEARS AGO, the "art" of greasemaking was handed down from father to son, or from the master greasemaker to his favorite apprentice. The greasemaker was a super-chef—his recipes a secret. Without

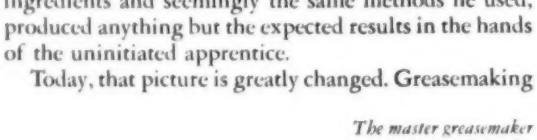


The "art" of greasemaking was handed down from father to son.

the magic word known only to the old-timer, the same ingredients and seemingly the same methods he used, produced anything but the expected results in the hands of the uninitiated apprentice.

Today, that picture is greatly changed. Greasemaking

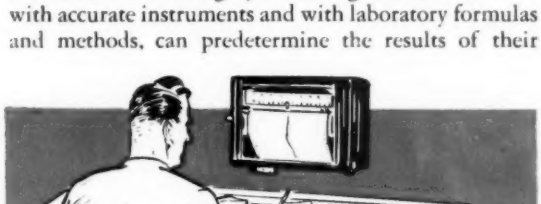
The master greasemaker was a super-chef—his recipes a secret.



is no longer an art but a science. The "know-how" of the old-timer is duplicated and improved upon in the chemist's laboratory.

Control of the various steps in the process, once dependent upon the experienced "eye" of the greasemaker, has been taken over by modern scientific instruments—accurate measuring and weighing devices, precision temperature control instruments, scientific mixing kettles, etc.

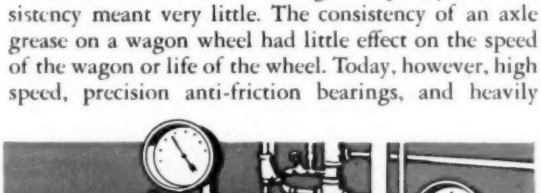
A high degree of skill is still required, but it is in the hands of thoroughly trained greasemakers, who, with accurate instruments and with laboratory formulas and methods, can predetermine the results of their



. . . accurate temperature measuring instruments.

labor and get uniform products that accurately meet specification requirements.

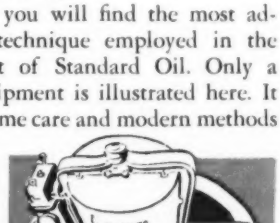
There was a time, too, when grease quality and consistency meant very little. The consistency of an axle grease on a wagon wheel had little effect on the speed of the wagon or life of the wheel. Today, however, high speed, precision anti-friction bearings, and heavily



. . . with laboratory formulas and methods.

loaded gears require accurate lubricant recommendations to save both power and wear.

All this explains why you will find the most advanced equipment and technique employed in the greasemaking department of Standard Oil. Only a small portion of the equipment is illustrated here. It can only indicate the extreme care and modern methods employed by Standard Oil to insure the highest quality and uniformity in the greases manufactured. And these include greases for practically every type of industrial application.



. . . scientifically designed grease kettles.

Standard Oil Lubrication Engineers will help you apply these products to give longer lasting protection to plant equipment and machines. Write Standard Oil Company (Indiana), 910 South Michigan Ave., Chicago 80, Illinois, for a Lubrication Engineer.

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STANDARD SERVICE

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What makes it so good?

Let's take a Badger Packless Self-equalizing Corrugated Expansion Joint "apart" to see what makes it "tick":

BADGER ALL-CURVE CORRUGATION DESIGN gives the corrugations of these joints a durability under flexing that is unsurpassed in any other design. . . . Flexing stresses naturally spread more evenly over the contour of such corrugations than over straight-side corrugations which encourage stresses to localize.

BADGER ALL-CURVE EQUALIZING RINGS (exclusive in Badger Joints) provide DIRECTED FLEXING. These rings further assure uniform distribution of stresses—not only throughout each corrugation, but also among *all* the corrugations in the joint.

BADGER PACKLESS CONSTRUCTION. Forming of the joint proper from a single piece of tubing eliminates the need of packing. This saves the expense of packing maintenance—and, consequently, of manhole and tunnel construction in underground installations.

BADGER SPECIAL HEAT-TREATMENT of joints after forming preserves their flexing qualities — and is an added factor in making these joints efficient, dependable and long-lived.

BADGER PACKLESS SELF-EQUALIZING CORRUGATED EXPANSION JOINTS are made in Copper for normal pressures and temperatures; in Stainless Steel for higher requirements—and where corrosion is a problem. Single and multiple corrugations—to take care of traverses ranging from a fraction of an inch upward. Also made in Non-equalizing type for pressures and traverses that do not require the added protection of equalizing rings.

FREE BULLETINS: *No. 100 on Self-equalizing. No. 200 on Non-equalizing.*

E. B. BADGER & SONS CO., 75 Pitts Street, Boston 14, Mass.
AGENTS IN PRINCIPAL CITIES

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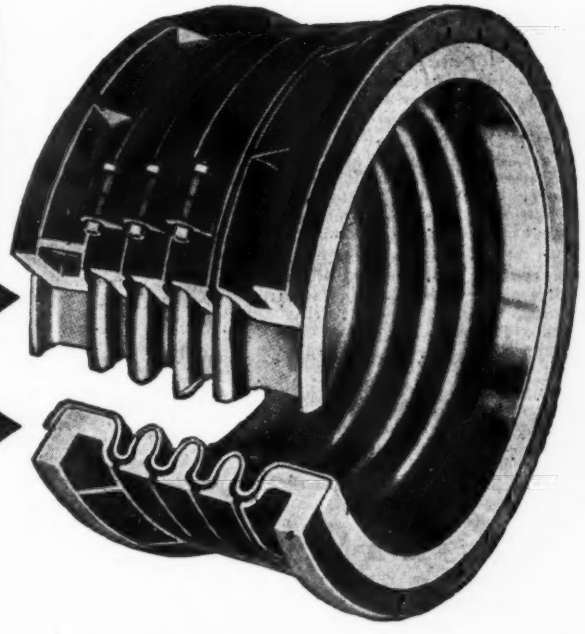
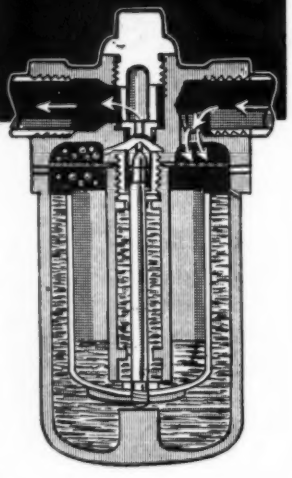


Badger

PACKLESS CORRUGATED EXPANSION JOINTS

STICKLE *Open Float* STEAM TRAPS



Efficient Drainage

Correct adaptation to drainage problem and proper installation are the only requirements for perfect service with Stickle Steam Traps. Abundant capacity. Operation perfectly simple, perfectly natural. When Open Float, or bucket, loses buoyancy, the trap opens for discharge. Regained buoyancy closes trap. Both actions instantaneous. Movement, up or down, small fraction of an inch. No friction, no sticking, no blowing of steam at end of discharge. Air and gases eliminated with each discharge.

Trouble-free Operation

Stickle Traps eliminate mechanical difficulties. There are no levers or hinges—no unnecessary parts to wear out or get out of order. Only moving part is Open Float. Small valve attached to bucket rod rotates with bucket as trap discharges giving continuous regrind to valve and valve seat to maintain smooth surfaces and proper fit.

Long Service Life

Many users say you can install a Stickle Trap and forget it! We are frequently told of Stickle Traps in constant use, and giving perfect service, for ten years and longer without repairs or even examination.

Series Designs and Sizes To Meet All Requirements

There is a Stickle Trap for practically any industrial requirement—traps for drainage of equipment operating at low, medium and high pressures or with vacuum systems—in series design to meet specific operating conditions and in sizes for handling required volumes of condensate.

Bulletins on Request

No. 115—Series 100 Stickle Traps, for straight-in-line installation. Capacity range, 250 to 5,000 lbs. per hour. Pressure range, 1 to 250 lbs.

No. 315—Series AE Stickle Traps, Capacity range, 5,000 to 40,000 lbs. per hour. Pressure range, 10 lbs. to 200 lbs. (regular construction)—in steel bodies up to 450 lbs.

No. 415—Series T Stickle Traps for low and medium pressures—including radiator traps, small and large utility traps and extra large capacity traps—and large capacity traps for vacuum service.

No. 515—Series 50 Stickle Traps for handling extremely large volumes of condensate from processing units operating at high pressures.

The Stickle Open Float

Basic to every Stickle Trap, the Stickle Open Float represents an obvious, simple and positive steam trap operating principle. It avoids complicated mechanism—therefore avoids trouble. Its action is natural—therefore almost effortless. It makes possible a rhythmic never-tiring performance, giving traps full efficiency and complete dependability.

OTHER STICKLE EQUIPMENT

Stickle Regulating and Reducing Valves
Ask for Bulletins Nos. 235 and 435

Stickle Differential Drainage and Boiler Return System
Ask for Bulletin No. 250

Stickle Triplex Oil and Steam Separators
Ask for Bulletin No. 200

Stickle Open Coil Feed Water Heaters and Purifiers
Ask for Bulletin No. 117

Stickle

STEAM SPECIALTIES COMPANY

2265 VALLEY AVENUE • INDIANAPOLIS, INDIANA

will indicate the current change. For test purposes the overcurrent trip can be raised long enough to obtain a curve showing full current increase. Motor should be carefully observed for heating during test period.

It is, of course, possible to take oscillograms of the generator wave shapes for several load conditions but this is not a simple operation.

C O VON DANNENBERG
Brooklyn, N. Y.

More About Correcting Field-Pole Polarity

ANSWERING George E Lyons' comments (p 847, Dec. 1944, POWER) on my short article in October, I might add that space limitations prevented giving all details on the use of separate excitation to correct dc-generator field polarity. First, an experienced operator does not open a field switch while the generator is running without load unless the switch has a discharge resistor. He knows that such an act might puncture the machine's insulation, or give him a severe shock or burn.

The diagram intentionally showed the field rheostat out of circuit when the field coils are energized from a separate source to correct their polarity. In our plant the separate excitation source is 32-v battery bus and this voltage on 250-v field coils can be interrupted safely without a discharge resistor. The generator never had a field-discharge switch and resistor. Even though one could have been used in place of the simple double-pole double-throw switch we installed, it was not considered necessary because of the low battery voltage.

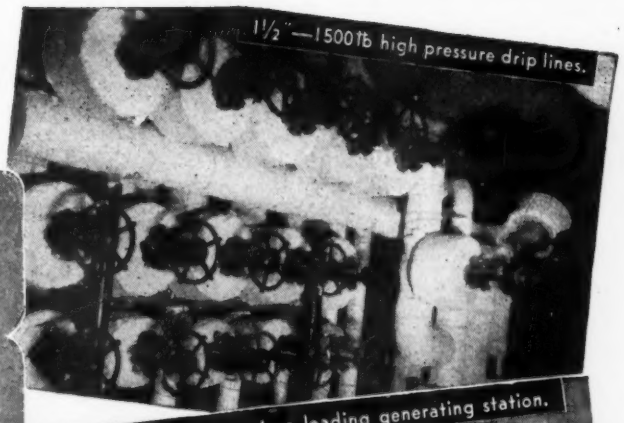
I am willing to admit that the way we use the separate source of excitation is not a 100% job but, handled intelligently, it does the trick. It is also convenient and always ready to be applied without hunting for wires, lifting brushes or guessing which connection gives the right polarity.

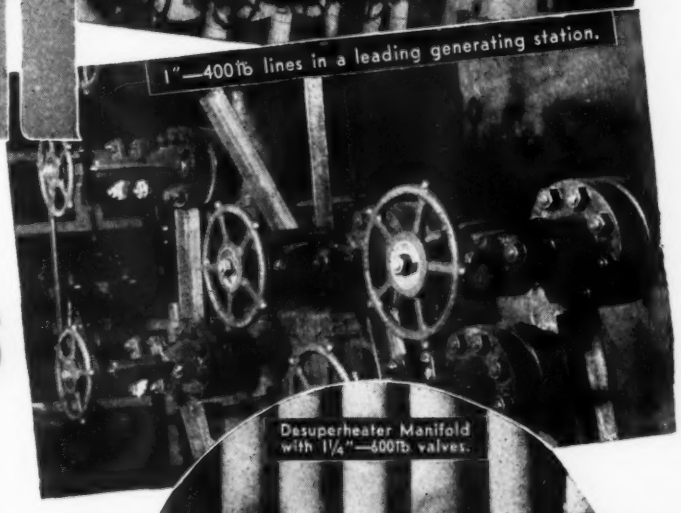
Mr Lyons method of leaving the circuit breakers open and closing the two main equalizer switches to put all series field circuits in parallel is good. However this method cannot always be used because the connections are so made on some machines that separate equalizer connections are tied in with the main breakers. Also, the operator must apply this method intelligently, as with mine, or the results may be even more disastrous if a mistake is made.

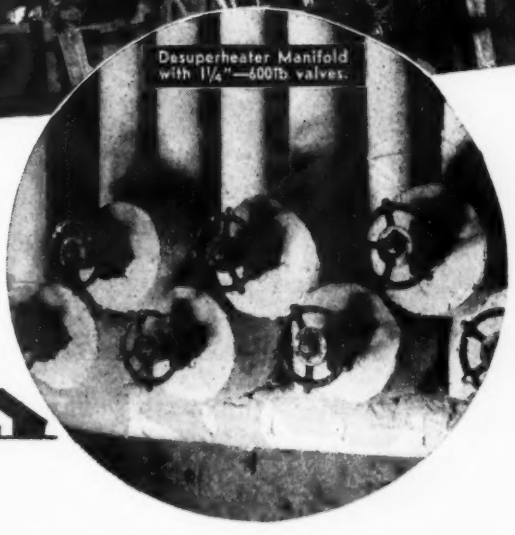
Ottawa, Ont. J BONCIORNO

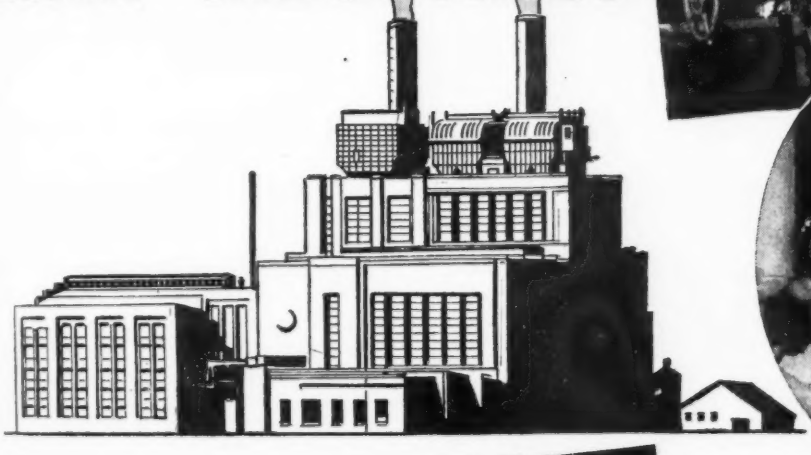
(*Continued on page* 156)

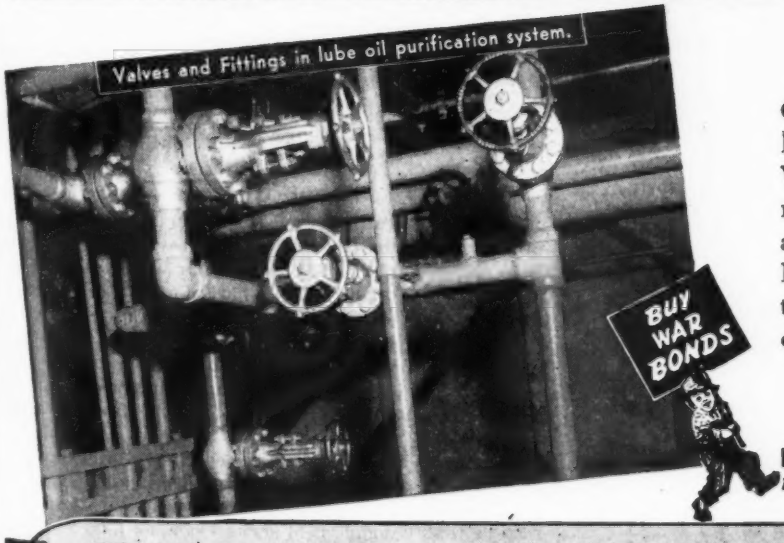
Uninterrupted POWER for WAR INDUSTRIES









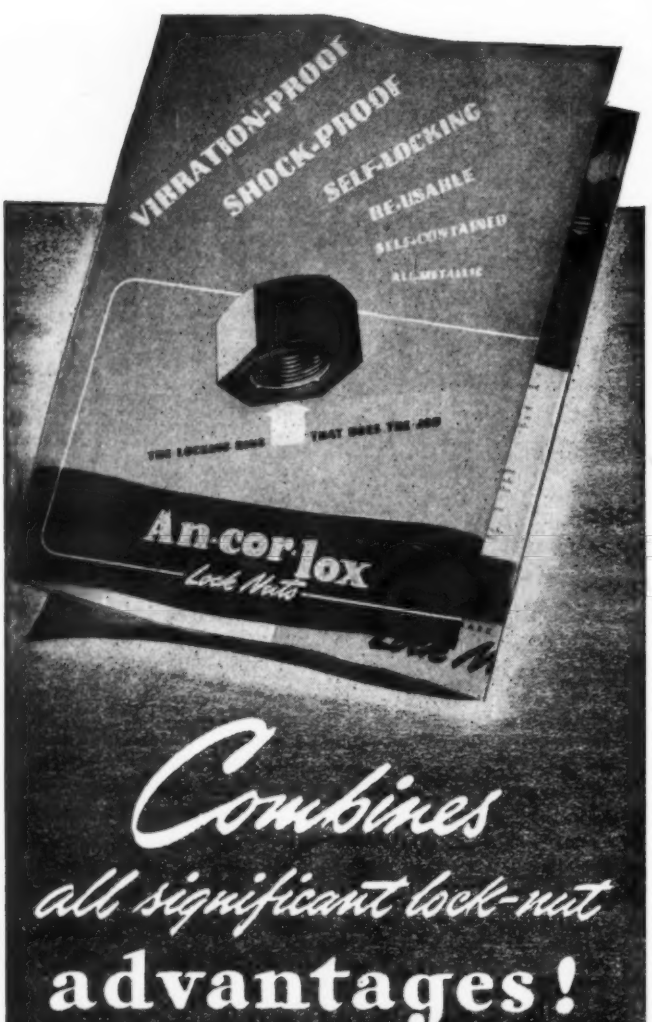


● SAFE and SURE control of vapors and liquids in steam generating plants serving our War Industries is dependent on piping materials having an inherent "plus" of strength and toughness. *Drop Forged Steel* Valves, Fittings, and Flanges made by Vogt continue to play a vital part in the smooth, efficient operations of America's leading power plants.

Catalog F-8 is the *drop forged steel* Valve and Fittings Blue Book.

HENRY VOGT MACHINE CO., Louisville 10, Kentucky
Branch offices: New York, Philadelphia, Cleveland, Chicago, Dallas.

Vogt DROP FORGED STEEL **VALVES, FITTINGS & FLANGES**



READ THE STORY of this advanced nut locking principle. • An-cor-lox lock nuts (patented) are helping many a wartime production, service and maintenance job. • Locking security; quick, simple installation; wide adaptability; An-cor-lox provides them all.

Write for the An-cor-lox bulletin —and your An-cor-lox sample. Demonstrate for yourself.

An-cor-lox
TRADE-MARK REG
Lock Nuts

An-cor-lox Division
LAMINATED SHIM COMPANY
Incorporated
61 Union Street • Glenbrook, Conn. 1877

Use a Differential-Controlled Valve

IF *PCJ's* PUMP (Reader's Problems, p 766, Nov, 1944) is in good condition it should perform satisfactorily in the system he has in mind. A 1720-rpm 5-hp pump should deliver approximately 125 gpm at 100-ft head. Since the cooler is operating satisfactorily on the present 15-psi supply, then at the present flow rate the pump would need to supply only the additional pressure necessary to overcome the friction and static head in the line to the storage tank. Therefore, unless the friction head is greater than 60 ft the cooling water flow should be increased.

If the pump is now in service, a test could be run without removing it from the line by throttling the discharge valve until the difference between the inlet and outlet pressures is about 40 psi. A barrel or tank could then be used to determine output.

The pump can be connected ahead of the cooler with a check valve that allows cooling water to bypass the pump if it stops, but that prevents a short circuit while the pump is operating. A valve in the sewer discharge could be either electrically or hydraulically operated and set to open if the pressure drops below a certain value in the line. An electrically operated valve could be connected to remain closed while the pump is running but which would open when it stopped. Still another method of controlling the valve to the sewer line would be to use a differential valve, which would be operated from the pressure drop across an orifice plate in the line to the storage tank. The valve would be set to open if the flow fell below a certain predetermined value.

Sherman, Texas R S BEAN

Impatient with endurance test methods that require five or six years, engineers at research laboratories of Westinghouse Electric & Mfg Co have devised test machines to check new high-temperature alloys in steam turbines, jet-propulsion units and other high-temperature machines. At room temperature, story of endurance of a metal is usually told in ten million cycles of stress. But at elevated temperatures, waning endurance curve continues downward for several hundred million cycles. By ordinary means, it takes years to stress an alloy sample held at, for example, 1500 F a quarter of a billion times. The special machines can do this testing job in a month.

Electronic photolight, or high-speed flash unit, gives a flash less than 4/1,000,000 of a second in duration, compared with ordinary bulb's several thousandths of a second.

Every Belt a Specialist

In Allis-Chalmers' Great New V-Belt Line!

When Allis-Chalmers recommends a certain belt for a certain job, you can be sure it's the *right* belt. Because: 1) the Texrope line is *complete;* 2) Allis-Chalmers invented the multiple V-belt drive, offers engineering advice based on unparalleled experience. Both sound reasons for making Allis-Chalmers your "V-Belt Drive Headquarters."

1

HEAT-RESISTING SUPER-7, made of Buna-S synthetic rubber, has ability to withstand heat built right into it. Standard Super-7 belt, it can successfully operate in ambient temperatures up to 180 degrees F.

2

OIL-RESISTING SUPER-7 specializes in operating under fairly bad oil conditions. Neoprene, a synthetic impervious to oil, grease, other grimy liquids, is the cover for the regular Buna-S Texrope V-belt core.

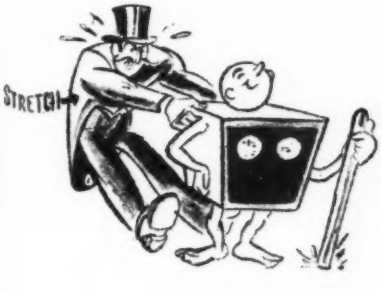
3

OIL-PROOF SUPER-7 is made of solid Neoprene, which is unaffected by most rubber-attacking liquids. It is recommended for drive installations where V-belts are virtually swimming in oil or grease.

4

STATIC-RESISTING SUPER-7 conducts static charge to machine to ground it. Static conducting element is contained throughout belt cover — can't wear off. This belt is used where explosion danger is present.

♪ *Tune in the Boston Symphony, Blue Network, every Sat. Eve.*



5

SUPER-7-STEEL employs endless cables of steel to reduce belt-stretch, provide greater horsepower. It is used where V-belt drive centers are hard to adjust, loads to be driven are extra heavy, space is limited.

A 1731

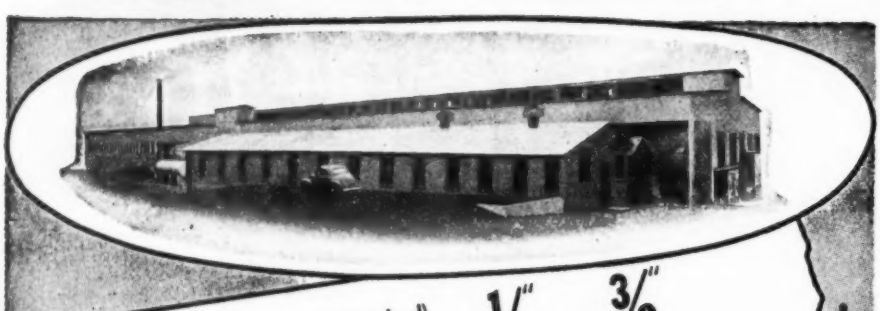
It pays to make

ALLIS-CHALMERS

your

V-BELT DRIVE HEADQUARTERS

Texrope Super-7 V-Belts result from the cooperative research of two great companies—Allis-Chalmers and B. F. Goodrich—and are sold exclusively by A-C.



Schedule No. 40 (Standard) and No. 80 (Extra Heavy)

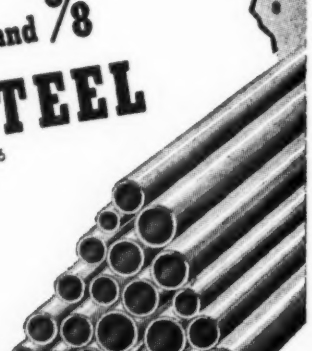
1/4 and 3/8

SEAMLESS STEEL

ASTM Specifications A53 & A106

PIPE and NAVY TUBING

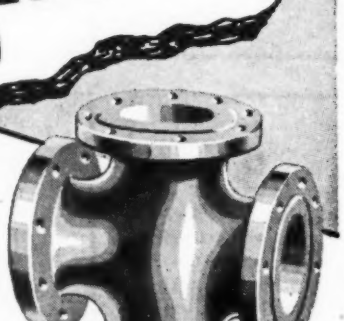
(44-T-13)

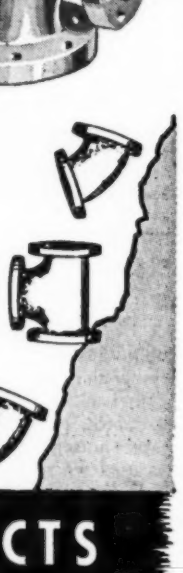


For all pressures and temperatures,

PTP

CARBON and ALLOY CAST STEEL FLANGED FITTINGS





PIPE & TUBE PRODUCTS

INCORPORATED

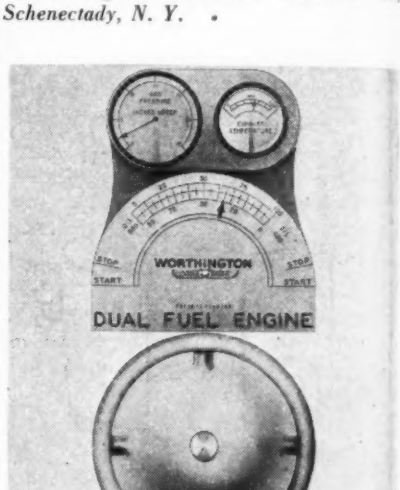
Manufacturers of Cold Drawn Seamless Steel Tubing

JERSEY CITY, N. J. • WORKS: READING, PA.

New Equipment

(*Continued from page* 126)

to step up power-supply voltage to six rectifier tubes, and such accessory items as a contactor, tap-changing switch and filament transformers. Other compartment contains high-frequency components—a single water-cooled oscillator tube and a bank of water-cooled capacitors. Meters and controls are conveniently mounted on front of two compartments, which are securely bolted together. *General Electric Co, Schenectady, N. Y.*



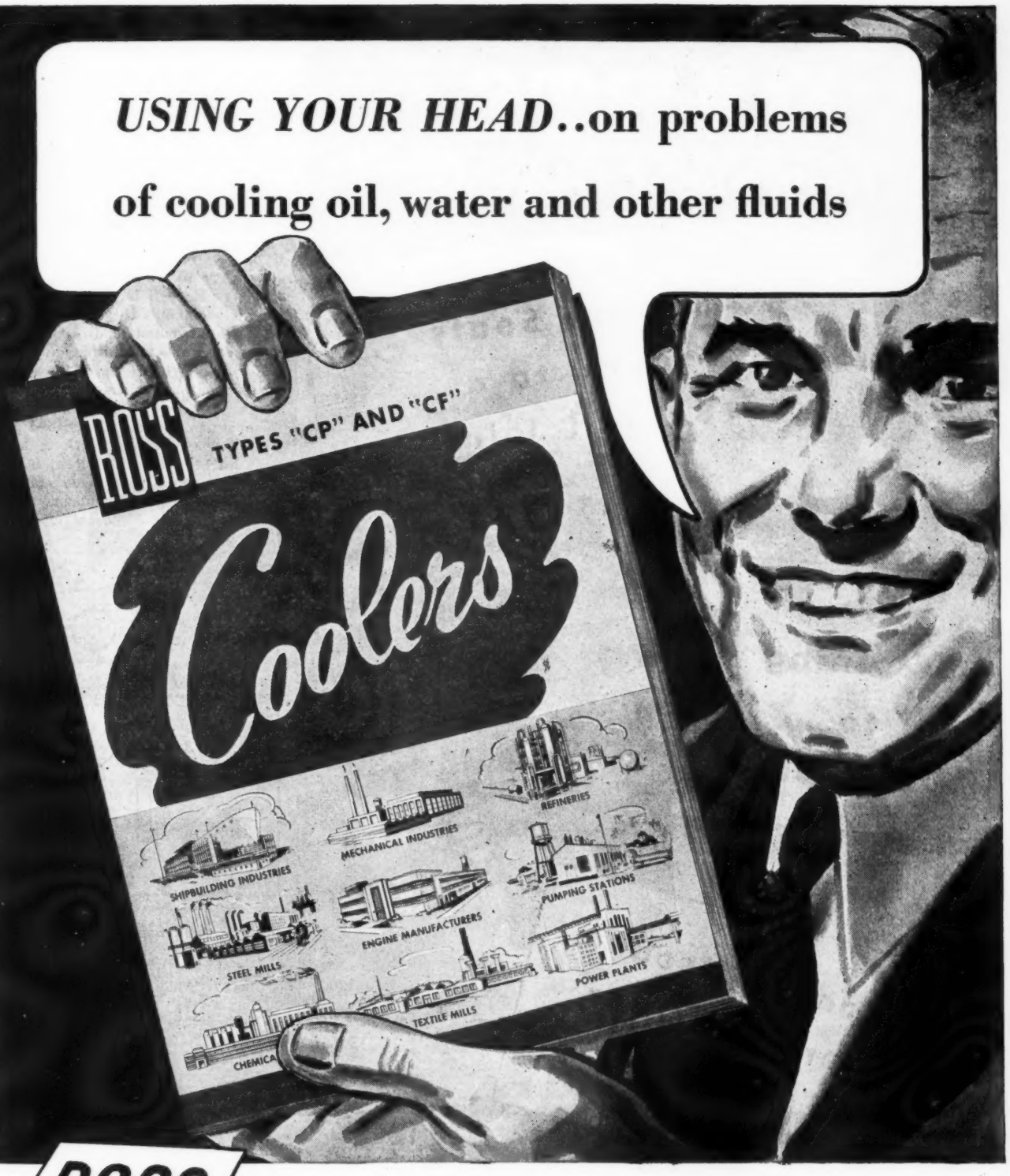
Dual Fuel Engine

WORTHINGTON UNIT is capable of instantaneous conversion from oil to gas fuel without change in load or speed. Conversion from one fuel to the other, or adjustment of a combination of both, is by one revolution of a single control wheel. Regardless of fuel, engine operates on the diesel cycle, thus realizing fuel economies heretofore unobtainable in gas-engine operation. Unit does not require a high-pressure fuel-gas supply to engine; gas pressure is two in. of water. When operating a gas engine, pilot-oil ignition is utilized, eliminating electric ignition. Pilot fuel can be held to amounts as low as 5% of total full load Btu requirements of engine. Fuel consumption as a gas engine is said to be appreciably less than that of a similar engine operating on conventional spark ignition otto cycle. This system applies to entire range of Worthington diesel sizes. *Worthington Pump and Machinery Corp, Harrison, N. J.*

Burn Treatment

HYDROSULPHOSOL OINTMENT and solution for burns are claimed to result from six years of extensive clinical tests. Ointment has powerful healing values through its chemical barrier to oxygen. *Hydrosulphosol* not only thwarts penetration by oxygen into scarred tissues, but by suffusing the damaged tissues breaks down oxidized cells and helps stimulate natural restoration of

USING YOUR HEAD..on problems of cooling oil, water and other fluids



ROSS

STANDARD COOLERS

Wherever oil, water or other fluids are circulated for heat removal, there's a Ross way of assuring highest cooling efficiency for your own conditions. First, have a Ross engineer analyze your individual problems. Second, avail yourself of a standard Ross cooler (each consists of standard parts, specially assembled to meet your own requirements).

For helpful information on large capacity units, write for Bulletin 5322.

For small capacities, write for Bulletin 4922.

ROSS HEATER & MFG. COMPANY, INC.

Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

1415 WEST AVENUE BUFFALO 13, N. Y.

DARTS

Fit Without Freezing

2 Bronze Seats Ground to a True Ball Joint

No Straining to Uncouple

Can Be Used Over and Over Again

Because its two bronze seats are ground to a true ball joint, the Dart Union makes a drop-tight connection without heavy wrenching. It uncouples as easily . . . can be used over and over again wherever needed. Made of high-test air-refined malleable iron, it is practically unbreakable. Ask your supplier to send Dart . . . the *real* economy union.

DART UNIONS LIVE LONGER

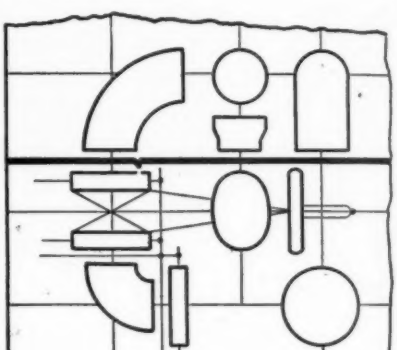
DART UNIONS

E. M. DART MANUFACTURING CO., PROVIDENCE, R. I.

injured tissues. Introductory material on this new sulfhydryl solution lists its major heading features as: quick relief from pain, infection control, acceleration of healing, nontoxic safety and stimulation of new tissues or repair of burned ones to check disability danger. *Davis Emergency Equipment Co, Newark, N. J.*

Dual-Purpose Terminator

J TERMINATOR, serving either as a terminator and sealing fitting or as a pulling or splicing chamber, is made in sizes for 1- to 4-in. conduit. It permits sealing and terminating conduits and cables outside of chambers without disturbing electrical installations. When installed with cabinets, conduit work is terminated at proper height below box. Device is dismantled and assembled on conduit end, then tied into box with a chase nipple, which is furnished with fitting. Oversized sleeve is of sufficient dimensions to provide ample room for pulling-in, belling, splicing and other processes. *O Z Electrical Mfg Co, 262 Bond St, Brooklyn, N. Y.*



Piping Template

NEW MACHINE-CUT celluloid template, 12x5 in., permits rapid and accurate drawing of piping layouts. It covers welding fittings and 150- and 300-psi ells, tees, flanges and valves for 3- 4- 6- 8- 10- and 12-in. pipe sizes. Corner illustrated shows template openings for one pipe size. Templates for isometric sketching are also available. *W H Nichols, 1055 W Granville, Chicago 40. Ill.*

Remote Controls

FOUR BASIC TYPES of new electric positioning controls are: (1) Continuously variable control is a nonsynchronous follow-up control provided with a repeat back indicator for positioning shaft of a reversible motor to any point of any revolution. (2) Multi-turn selector is a motor-driven device whereby its connected load may be placed in any one of several adjustable positions over one or a number of revolutions. (3) Dual control incorporates features of both continuously variable control and multi-turn selector. By this combination, operator may position load to any one of the preset positions or, by turning knob, to any point over full range. (4) Integrating selector pro-

Because power plants need CONDENSER TUBE PLATES

Revere Condenser Tubes are preferred because of their long, satisfactory service, and so are Revere Plates, for the same reason. The two make a perfect combination, both being made with the same high skill, to the same standards.

Our long experience makes it possible to deliver to you plates that are dense, free from blow holes and surface imperfections, characterized by flatness, accuracy of gauge, machinability and resistance to corrosion.

Revere Condenser Tube Plates are available in squares, rectangles, circles, half-circles, segments, patterns, up to 120 inches. Finished weight, up to approximately 11,000 pounds. Metals include Admiralty Metal, Muntz Metal, Naval Brass and Cupro-Nickel, where authorized. Revere Condenser Tubes are available in these, and also in Revalon (aluminum brass). Other Revere products for power plants include copper tube and pipe, Red-brass pipe, copper bus bar, Herculoy (silicon-copper alloy) in plate, sheet, strip, rod, forgings. For advice in the selection of the proper non-ferrous alloys for your purposes, write the Revere Executive Offices.

Pouring a 12,000-pound cake of Revere Cupro-Nickel for a Navy Condenser Tube Plate.

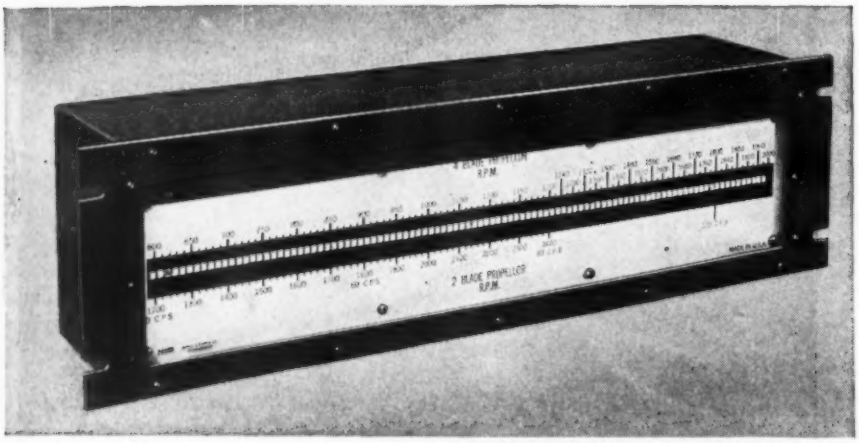
REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

Executive Offices: 230 Park Ave., New York 17, N.Y.

"FRAHM" *Resonant Reed* INSTRUMENTS



Frahm Frequency Meter with one row of 101 reeds. A recent development for a government agency.

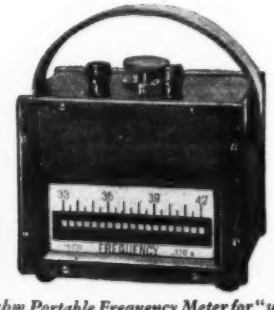
NEW MODELS ... *New Applications*

The resonant reed principle as applied to the measurement of speed, frequency and rates of vibration, first introduced in this country by Mr. James G. Biddle in 1910, has been widely adopted for a variety of services. During recent years, we have been called upon to develop units for special applications far removed from the original simple measurements of speed and frequency. Some of these special purpose instruments are shown here; some have already been standardized for regular production.

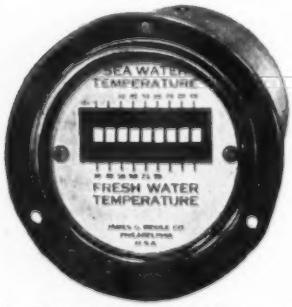
We invite correspondence regarding problems that may be solved through measurements of frequency and rates of vibration. Our accumulated experience in the development and use of Frahm Resonant Reed Instruments should prove of value in suggesting an application for your particular requirements.

Write for Bulletin 1755-P.

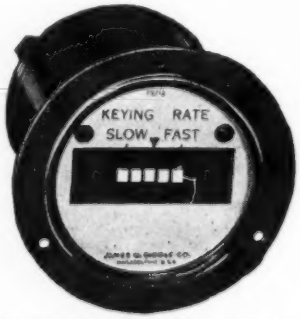
Frahm Electric Tachometer, 4 groups of reeds in the same range to aid in synchronization of the speeds of 4 engines.



Frahm Portable Frequency Meter for "series" operation in testing a special telegraph circuit.



Frahm Frequency Meter used in connection with apparatus for determining temperature of salt and fresh water.



Frahm Frequency Meter for use in a special electronic circuit. Used in a device for geodetic surveying.

JAMES G. BIDDLE CO. 1211-13 ARCH STREET PHILADELPHIA 7, PA.

vides automatic setting of load to a large number of positions by a small number of pushbuttons.

These small devices are lightweight and depend entirely on electro-mechanical principles. They are built for any current characteristics. At present entire output is for Navy. *Remote Control Div, American Type Founders, Inc, 11 W 42nd St, New York 18, N. Y.*

Controllable Capacity Pumps

ALDRICH-GROFF 3-in. stroke 20-hp unit has recently been added to line. Introduced four years ago, line now consists of 20, 40, 60 and 100-hp units, which cover a wide range of capacities at various pressures up to 15,000 psi. Pumps are for boiler feeding, desuperheater feeding, pipeline, process charging and proportioning. Operated at constant speed from no-load to full-rated capacity power consumption is practically proportional to discharge. *Aldrich Pump Co, Allentown, Pa.*

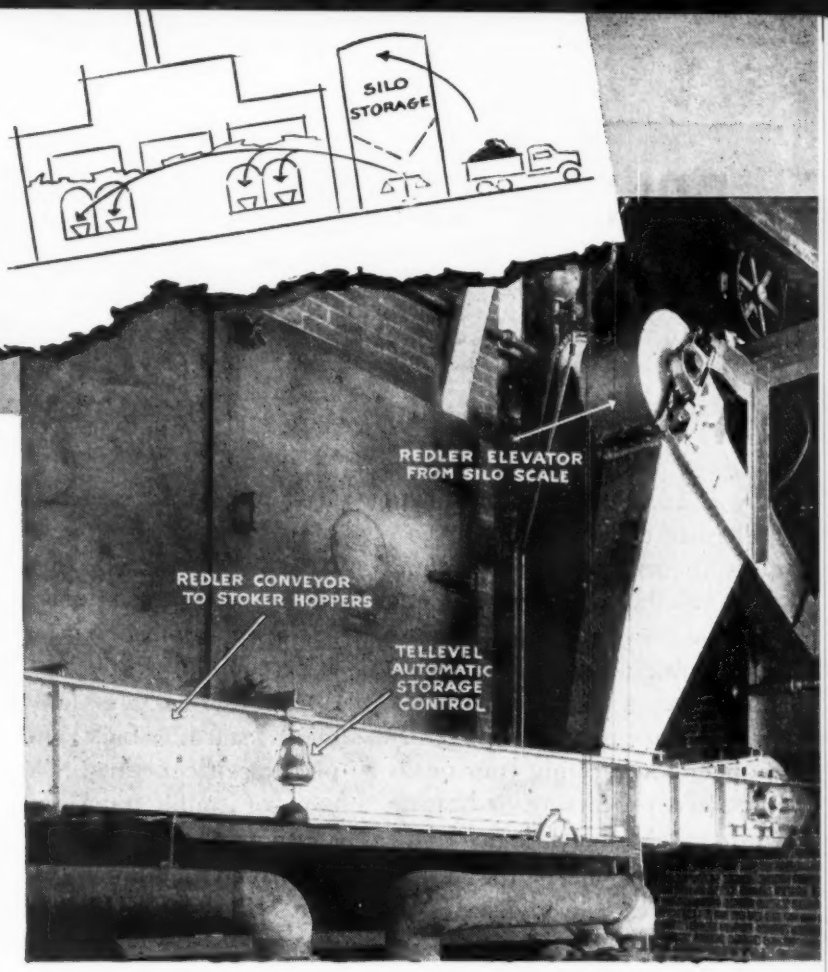
Material Pumps

VERSATAL MATERIAL PUMP dispenses and applies paints, lacquers, mastic, sealers, insulating materials, etc.

Features of *Versatal* include: (1) Air regulator provides a convenient, accurate method of controlling air pressures introduced to pump mechanism. This permits ready adjustment of working pressures in accordance with job requirements. (2) Visible air pressure gage tells operator at a glance amount of air pressure introduced to pump. (3) Air motor oiler is equipped with transparent oil reservoir. Automatically feeds oil through air line to air motor of pump. (4) Air-motor powered pump has sturdily built, fully inclosed, sealed and tamperproof air motor above level of material being pumped. Develops working pressures $4\frac{1}{2}$ to $5\frac{1}{2}$ times that of air pressure. Eliminates necessity of maintaining air head in material container. (5) Automatic agitation provides for continuous circulation of material being dispensed without moving parts. (6) Dual air and material outlets provide for easy attachment of hose or pipelines. (7) Pump and material lines may be cleaned easily by placing intake pipe in a container of solvent and operating.

Versatal pumps are in several types and sizes. Model 7804-C, stationary barrel

The Problem—
a modern system for
(1) Storing coal
(2) Reclaiming in weighed amounts for delivery direct to stoker hoppers



THIS AUTOMATIC, HIGHLY EFFICIENT SYSTEM IS THE S-A ANSWER

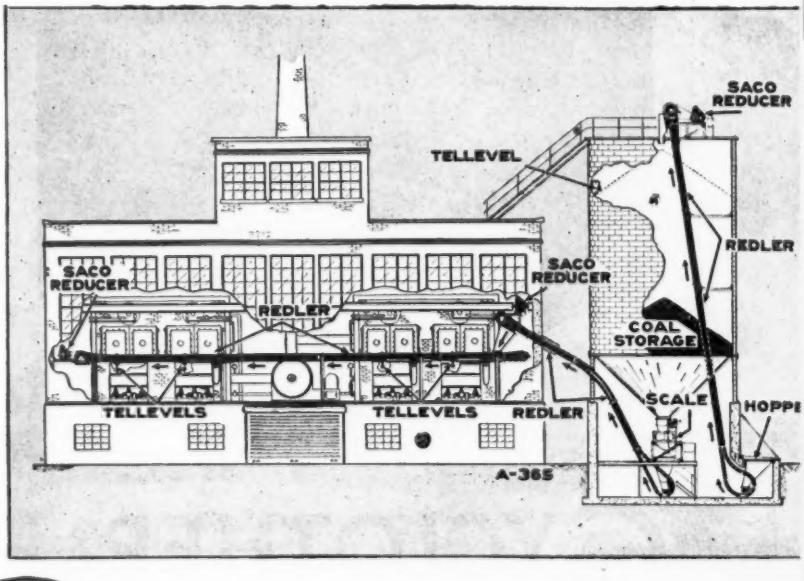
• From trucks to storage silo to scale to stoker hoppers—those are the steps required to handle coal at this power plant. Formerly served by open type, space wasting equipment, three REDLERS now accomplish all operations with greatly increased efficiency.

As shown in illustrations, one REDLER Elevator and two Conveyors handle coal from trucks to boilers. Benefits made possible by this engineered system are automatic weighing of measured amounts of coal from silo . . . automatic feeding of four different stoker hoppers . . . complete absence of dust since coal is enclosed in sealed casing at every handling stage . . . extreme compactness and elimination of open bunkers and bulky larry.

Let S-A engineers help you achieve comparable advantages at your plant. Write us today.

Above: View at junction of REDLER Conveyors at first stoker hopper.

Below: Diagram indicates simplicity and compactness of closed REDLER system. Key unit is the long, horizontal conveyor running full length of boiler room directly over stoker hoppers, feeding any one or all of them by gates. S-A TELLEVEL regulates coal flow and automatically operates conveyor system.



STEPHEN S-A DAMSON MFG. CO.

RIDGEWAY AVENUE, AURORA, ILLINOIS — LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

Designers and Manufacturers of All Types of
BULK MATERIAL HANDLING EQUIPMENT

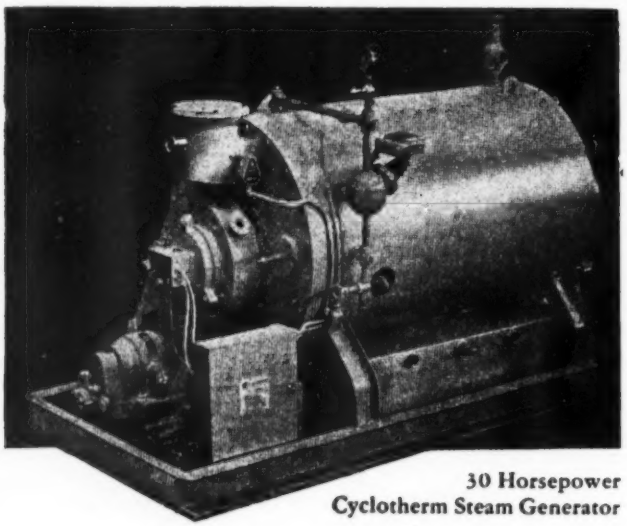
DOLLAR EFFICIENCY—work done per dollar spent—measures the value of steam generation

If you are planning immediate boiler installation or replacement, the efficiency and economy of a Cyclotherm Steam Generator will interest you. While the range of available units obviously cannot be on a peace time basis, Cyclotherm engineers will gladly cooperate in meeting your needs in power, processing or heating with available units.

Cyclotherm meets the dollar efficiency test through a wide power range (10 to 300 horsepower) with both oil and gas fired units. Its exclusive principles of combustion and design have proved Cyclotherm's dollar saving and dollar making capacity under most rigorous operating conditions.

Cyclotherms are fully automatic, sturdily built and completely self contained. They give years of trouble free service with a minimum of attention.

Detailed additional information will be supplied promptly upon request. Our engineers are available for consultation.



30 Horsepower
Cyclotherm Steam Generator

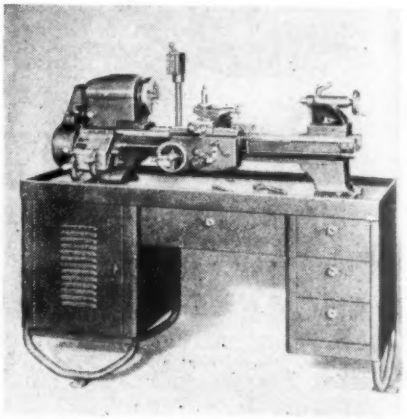
CYCLOTHERM
STEAM GENERATOR

AMES IRON WORKS
OSWEGO . . NEW YORK . . BOX 702

pump, handles fluid materials. There are also portable pump models which come complete with an attached 12-gal material container. *Alemite Div, Stewart-Warner Corp, 1826 Diversey Parkway, Chicago 6, Illinois.*

Acidproof Apron

HEAVY-DUTY APRON is made of a treated fabric combined with a new plastic by a special calendering process which impregnates the fabric so that product is acidproof. Apron is in one size only, 35x47 in., and weighs 1¾ lb complete with sturdy ⅞-in.-wide tape, criss-cross shoulder design, attached securely with reinforced grommets at top and side and with edges hemmed throughout. It can be easily washed or cleaned without harm to its acidproof qualities. *B F Goodrich Co, Akron, Ohio*



Gear Cabinet Lathe

COMBINING ALL FEATURES of standard Logan quick-change gear lathe in a compact cabinet, new ruggedly built Logan No. 825 lathe is adaptable to tool-room work, for maintenance, training or production. Power plant and underneath drive are inclosed in left compartment of 4-drawer stipple-finish gray steel cabinet. Multiple V-belt drive transmits power from cone pulley to spindle. Adjustments of both flat and V-belt tensions are easily accessible to operator. Unique 3-point base assures a steady installation on any floor. *Logan Engrg Co, 4901 W Lawrence Ave, Chicago 30, Ill.*

Overload Release Coupling

BASED ON A NEW PRINCIPLE, overload release clutches and couplings are claimed to give instant, positive and complete release when loaded beyond torques they are adjusted to transmit. Major parts of overload mechanism are a hub mounted on shaft, sliding jaw ring splined to hub, revolving jaw ring free to turn on hub when jaws are not meshed, special *dished* actuating spring, which applies pressure to jaws, and adjusting nut threaded on hub. Kept in driving contact until actuating spring starts to deflect in presence of an overload, jaws are drawn apart by special characteristics of

DEXTER HELPS SOLVE MY UPKEEP PROBLEM

. . . Says the Maintenance Director

It makes a crew job a one-man job!

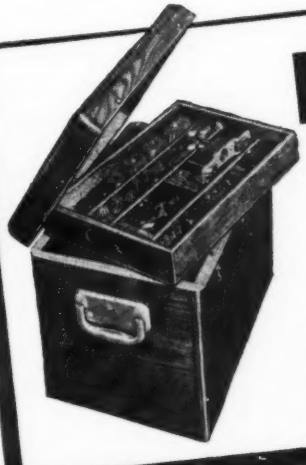
It's tough keeping down maintenance costs these days — and every unnecessary job eliminated means a better record for my department. The Dexter Valve Reseating Machine has eliminated the expense of a crew that formerly had to spend hours repairing or replacing leaky valves in the plant. Now — one man reseats the valve, skillfully, effectively, *right on the line*, in a few minutes.

And, of course, many more production hours are saved by eliminating long shutdowns while valves are replaced. No more morale-breaking layoffs either.

Our engineers are Dexter boosters, naturally, Dexters stop those big valve-leak losses in air, steam and water — and the reseated valves actually perform better than new ones.

★ ★ ★

A large part of our production facilities is devoted to war work. Orders for Dexter Machines and Cutters, from firms who want this economy and efficiency, have far exceeded our non-military manufacturing facilities. Please be patient — we will deliver just as quickly as possible.



DEXTER VALVE RESEATING MACHINES AND CUTTERS

for Globe, Gate and Pump Valves

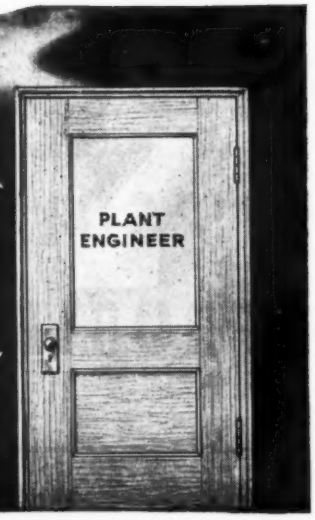
Write Today . . .

for information on the Dexter Reseating Outfit to keep your valves in shape. Give make, type, size and material — whether steam, air or water. No obligation.

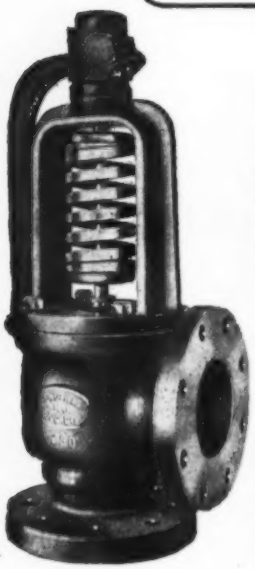
22

THE LEAVITT MACHINE COMPANY
ORANGE, MASSACHUSETTS

WHY Should I Specify This FARRIS Safety Valve?



That's a good question Mr. Engineer!



Farris Safety Valve No. 2350. Meets ASME code. Flanged or screwed outlets. Semi-steel (40,000 tensile) for pressures to 250 lbs., 450° F. Cast steel for pressures to 600 lbs., 750° F. Sizes 2" to 6" x 8". Or in bronze, ½" to 2".

Here's the answer—

This FARRIS Safety Valve #2350 gives you the advantages of economical first-cost and very low (if any) maintenance expense. It meets ASME specifications. Proven by thousands of installations to be trouble-free, dependable, accurate. Now that's a hard-hitting combination worth specifying!

This is how FARRIS does it—

The unique design of this FARRIS Valve disc develops a very high coefficient of lift, as established by the National Boiler Laboratories, Ohio State University. The disc entraps the high velocity secured by the full inlet port design, converting the kinetic energy into additional lift for high capacity discharge.

The FARRIS spring—long, exposed, accurately calibrated—controls and regulates the high lift action. It delivers accurate blow-down relief at the exact pressure set for its protection of your equipment.

FARRIS "Precision Alignment" of spring, stem, disc guides, and seat, is accomplished by precision machining—another feature of every finished surface in a FARRIS valve. Through close-tolerance alignment, and sensitive adjustment of the single blow-down ring, precision reseating of the disc on the seat is secured the instant over-pressure is relieved to normal. Thus, non-shock economical blow-down results. You're safe . . . and ahead in all ways—*Always!*—when you specify this FARRIS Safety Valve, Mr. Engineer.

Our valve engineers will be glad to help you solve any Safety or Relief Valve problem. And your inquiry for our Specifications Bulletin will be appreciated. Write today!

FARRIS ENGINEERING COMPANY
366 Commercial Avenue, Palisades Park, N. J.

Farris
SAFETY *and* RELIEF VALVES

spring after action of mechanism has been started. Once started, this action completes itself even though torque applied to clutch does not increase.

Re-engagement of mechanism merely requires lining up jaws and exerting pressure on sliding jaw ring to force jaws together. Spring completes the action, closing jaws after it has been partially depressed. *Hilliard Corp, Elmira, N. Y.*

Boring Bar

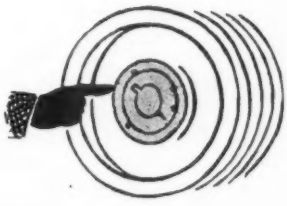
CLARK LEVER-LOCK BORING BAR has separate tool bits for small diameter holes. Presented as a companion tool to Clark adjustable tool holder, these new boring bars come in sets of four—$\frac{3}{16}$ x 5 in., $\frac{1}{4}$ x 6 in., $\frac{3}{8}$ x 7 in. and $\frac{1}{2}$ x 8 in. For use without bushings or adaptors, they require no special clamps or holders. Parallel-type adjustable tool holders hold them securely. Evenly distributed pressure of lever-lock clamp prevents breakage which frequently

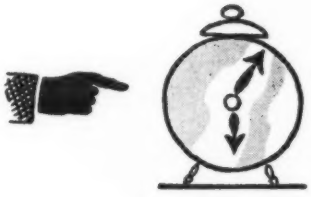
occurs when pressure is applied only at one point by a setscrew. Lever-lock feature securely grips tool bit in such a way that boring or threading to hole bottom is possible without interference from setscrews or bolts.

One precision-ground high-speed threading bit and one boring bit are provided with each boring bar. Lever-lock holds tool bit at a right angle on one end and at a 15-deg. angle on opposite end. Replacement cutters are made from round carbon or high-speed steel drill rod. Thus use of expensive solid-forged bars is completely eliminated. *Robert H. Clark Co, 9330 Santa Monica Blvd, Beverly Hills, Calif.*

Cable Terminator

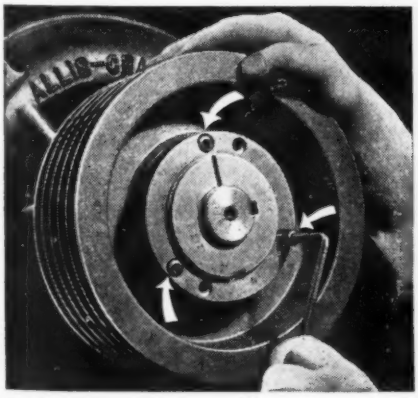
HORIZONTAL CABLE TERMINATOR with single or multiple cables up to 750 v, for lead, rubber or braided covered cable, can be furnished in malleable iron (cadmium plated), bronze or aluminum, for conduits 1 to 6 in. Pressure bushing on head compresses split rubber rings placed around cables between two canvas Bakelite disks. Fitting is thus sealed, preventing the compound from leaking out in any position. In addition to regular installations, this device

This  Saves:

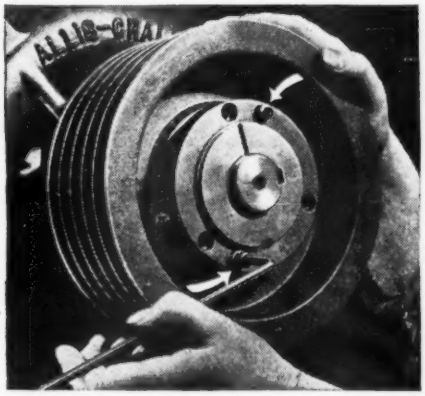


and

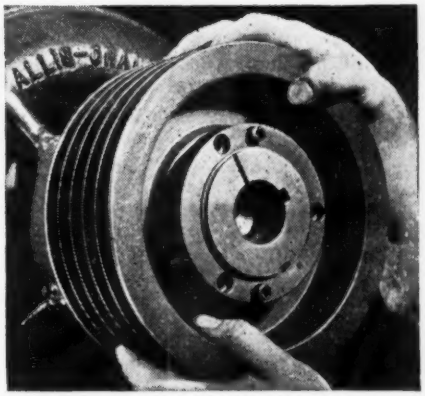
Yes, you save all three — time, money, trouble — with Allis-Chalmers' new "Magic-Grip" . . . *fastest mounting and demounting sheave on the market.* Three easy steps do it!



1 **Remove three capscrews** from bushing collar. A handy wrench — supplied with each sheave — is the only tool needed to remove Allis-Chalmers' new "Magic-Grip" from motor or machine shaft quickly and easily.



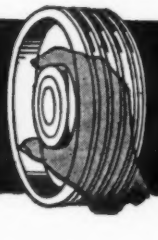
2 **Insert two capscrews** in tapped holes. As screws are turned, they become levers . . . automatically breaking tight grip of tapered split bushing on sheave and shaft. Entire unit is then ready for removal.



3 **Remove sheave from shaft.** Requires no mallet, no prying, no bulging muscles. You just slide the sheave off . . . smoothly, quickly. *It costs nothing extra!* Send for B6310. Allis-Chalmers, Milwaukee 1, Wis.

A 1760

Allis-Chalmers Texrope

"MAGIC-GRIP"  SHEAVES

Buell's assurance of...

HIGH EFFICIENCY LOW MAINTENANCE LONG LIFE

BELIEVING that progressive plant executives and engineers will welcome detailed information pointing up the reasons for industry's growing preference for Buell's advanced design in high-efficiency dust collecting systems, Buell will inaugurate a series of six explanatory advertisements descriptive of the engineering factors largely responsible for Buell's constantly increasing installations.

Look for these enlightening dust recovery messages in leading industrial and engineering publications. They will technically detail the advantages of the six outstanding Buell features briefed below.

1. *The "Shave-Off"*... The patented van Tongeren principle, exclusive with Buell. Utilizes the "double eddy" current, establishing a highly efficient collection force.

2. *Large Diameters*... Permit use of extra thick metal. Afford large dust outlets, prevent clogging. Reduce abrasion.

3. *Extra-Sturdy Construction*... Rolled and welded, one piece construction; hoppers braced with 3" channels to withstand vibration.

4. *Correct Hopper Design*... Plays a most important, often disregarded, part in dust collection efficiency. Dust disposal facility must be anticipated in the initial overall design.

5. *Split-Duct Manifolding*... A prime factor in efficient distribution of the dust load. Buell's manifolding method has flexibility, discharging gases from any side or end.

6. *Inner Welds Ground Smooth*... Proper finishing of inner welds effects operating efficiency, reduces erosion, ensures longer life.

buell
DUST RECOVERY SYSTEMS

The interesting Buell book—*"The van Tongeren System of Industrial Dust Recovery"*—has been especially prepared for operating executives and engineers.

BUELL ENGINEERING COMPANY, INC.
10 Cedar Street, New York 5, N. Y.
Sales Representatives in Principal Cities

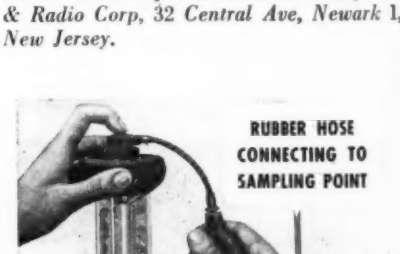
DESIGNED TO DO A JOB, NOT JUST TO MEET A "SPEC"

may be used on conduits that pass through chambers or rooms in cold storage vaults, air chambers or rooms having non-hazardous gases or fumes. *O Z Electrical Mfg Co, 262 Bond St, Brooklyn, N. Y.*

Selenium Rectifiers

CENTER CONTACT, a patented plate construction in metal-plate rectifiers, allows complete coating protection against destructive atmospheres. This construction permits a new method of applying protective coatings to metal-plate rectifiers. Where standard petal contact is sprayed with a protective coating, *Center Contact* is especially adapted to application of a heavier and better coating to protect rectifier from fungus-bearing, salt-spray-laden or corrosive atmospheres. *Center Contact*

is in same size range and capacities as standard petal contact. It retains features of high-voltage per plate, ability to withstand heavy temporary overloads and, according to maker, operates at high efficiency over a wide capacity range with no maintenance expense. *Federal Telephone & Radio Corp, 32 Central Ave, Newark 1, New Jersey.*

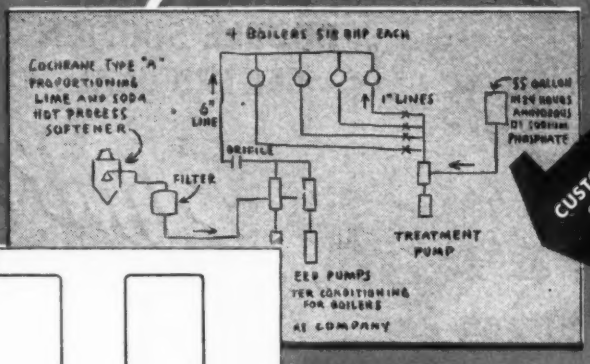


Oxygen Indicator

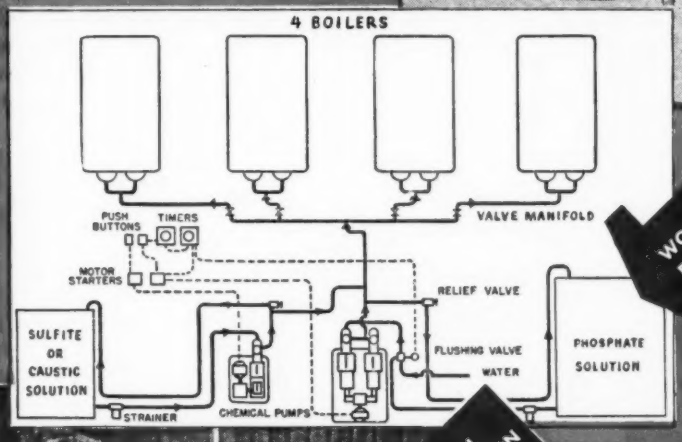
PORTABLE GAS ANALYZER employs fundamental *Fyrite* principle of chemical absorption. Its accuracy is not altered by vibration or shock. Sample of gas or atmosphere to be tested is pumped into oxygen indicator with aspirator bulb. Release of finger pressure on connector at rubber tubing end automatically locks sample in calibrated measuring chamber. *Fyrite* is then turned bottom-side up and back again, which causes absorbing fluid to mix with sample. Oxygen absorption creates a suction, which draws absorbing fluid up into the graduated tube in an amount equal to O_2 absorbed. Thus level of fluid column shows O_2 percentage, which is read directly on graduated scale. Standard range is 0 to 20%. *Bacharach Industrial Instrument Co, 7000 Bennett St, Pittsburgh, Pa.*

A *Working* PRINCIPLE

Adding the *proper* treating chemical, in the *correct* proportion, in the *right* location, at the *right* time.

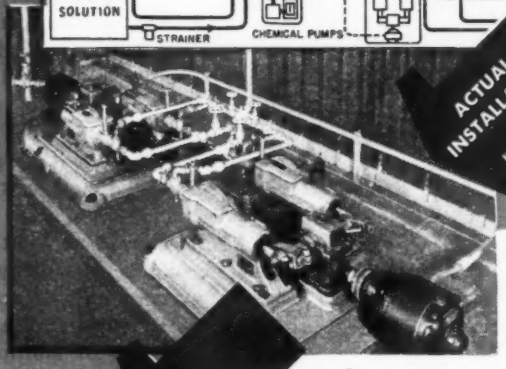


CUSTOMER'S SKETCH



WORKING DIAGRAM

TO *Mechanize* YOUR BOILER WATER CONDITIONING



ACTUAL INSTALLATION

The success of your chemical treatment depends on strict adherence to an operating program. In many cases insufficient importance is given to the *method* and *regularity* with which the treatment is injected. By using the tried and proven %Proportioneers% system, you eliminate guesswork, assure accurate treatment, safeguard your boiler investment, improve heat transmission, save fuel and reduce costly shutdowns for repairs and cleaning.

Ask for Bulletin 1713

Continuous AUTOMATIC WATER CONDITIONING WILL WORK FOR *You*

% PROPORTIONEERS, INC. %

WRITE TO %PROPORTIONEERS, INC.% 16 CODDING ST., PROVIDENCE 1, RHODE ISLAND

Now Ready!

Catalog A-145, just off the press, covers an entire range of Centrifugal Pumps especially engineered for industrial, municipal and other water supply systems. Cross-section illustrations, performance curves and structural details show at a glance why users of Economy Pumps save in cost, power, labor. Selection tables simplify the choice of exact types and sizes to handle specific requirements. A copy of the Catalog is yours for the asking, on your letterhead. So are the services of our engineering staff—for special problems—without obligation.

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ECONOMY PUMPS, INC.

HAMILTON, OHIO • U. S. A.

FOR OVER THIRTY YEARS MAKING BETTER PUMPS DO MORE

Power-Plant Cleaning

(*Continued from page 74*)

with thorough flushing with clean water and a final security rinse with a mildly alkaline solution, such as a weak solution of soda.

This general procedure for solid acid cleaners may usually be followed on the water or steam side of virtually all kinds of heat exchangers, including feedwater heaters, evaporators, hot-water heaters, oil coolers and heaters, etc. It applies equally to the water jackets or the complete cooling circuit of air compressors, diesels and gas engines. Since deposits usually consist largely of carbonates, provide for venting the gas generated when the acid attacks the scale.

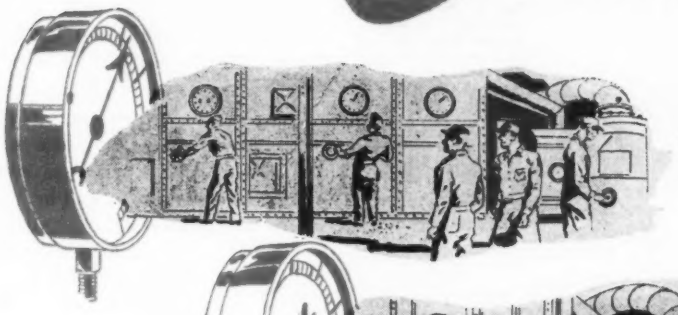
Steam and water meters require more or less special cleaning. Dismantle meter and immerse housings and other parts in a small tank of cleaning solution at room temperature. Fifteen minutes after gas evolution ceases, rinse parts in clean water and give a security rinse in weak alkaline solution before final rinsing and reassembly. If oil or grease is present, pre-treatment with an alkaline cleaner may be desirable.

Size and other mechanical considerations make acid cleaning of boilers another special case. Liquid acid cleaners are preferred for the large areas to be treated as solid cleaners take an unduly long time.

Before cleaning, shut unit down and allow to cool. Provide adequate venting at top of system to allow gas generated by cleaning action to escape. Estimate amount of cleaner by multiplying area by estimated average scale thickness (both in inches), then allow 1¼ oz per cu in. of scale. However, always have enough cleaner in solution to provide a concentration of at least 8%. Where estimate shows a smaller amount than the 8% factor applied to boiler's water capacity, use the larger figure. For convenience, figure 1½ pints of liquid acid cleaner per sq ft of boiler surface area per 0.1 in. of scale thickness.

Wherever possible, circulate the solution through the system for continual replacement of active solution over all areas, particularly for pockets or restricted passages. Use a pump or compressed air. The latter gives more satisfactory results, possibly because it provides more turbulent flow and a vibratory movement that improves the action. From 5- to 10-psi air pressure is usually needed, depending on type of pressure tank and head of solution in it. It is desirable but not essential that injec-

FOR PREHEAT *Continuity*



AT FULL LOAD

AT LOW LOAD

Metal Temperature Control is Available for

LJUNGSTROM AIR PREHEATERS

• Deposit formation on the preheater heat-exchange surface is a condition which generally accompanies operation to secure maximum heat recovery under low loads. To forestall this formation of deposits, the Air Preheater Corporation has developed a Metal Temperature Control system which keeps metal deposit-free under widely fluctuating loads and varying fuels.

To insure proper combustion of powdered fuels, primary air must be supplied at a temperature sufficient to dehydrate the fuel. To prevent deposit formation, metal temperature of the heat exchange surface must be kept above the dew-point. The Ljungstrom system of metal temperature control maintains necessary temperatures at these two critical points. It is readily installed on any Ljungstrom Preheater, and is available for either manual or fully automatic operation.

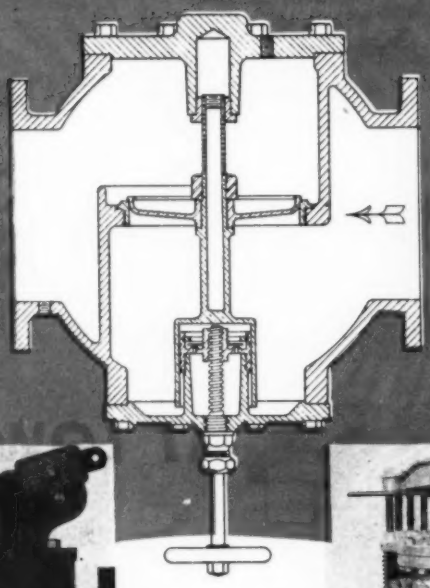
Essentially the system consists of an arrangement of thermocouples and dampers, designed to maintain metal and primary air temperatures, through bypassing part of the cold, incoming combustion air around the preheater. A folder giving a complete description and engineering information will be sent you upon request.

ENGINEERING SERVICE — The engineering staff of the Air Preheater Corporation is prepared to assist you in applying standard or special types of Ljungstrom Preheaters to your fuel conservation needs, or to help you and your engineers make better use of low-grade, more abundant fuels.

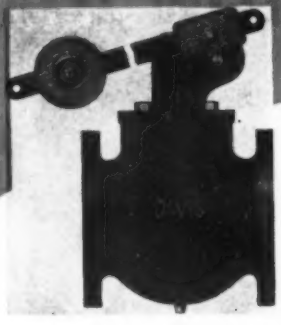
THE
AIR PREHEATER
CORPORATION

Executive Offices: 60 East 42nd Street, New York 17, N. Y. • Plant: Wellsville, New York

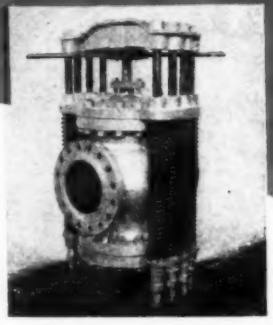
DAVIS AUTOMATIC RELIEF VALVES



Left — No. 110 Exhaust Relief Valve for condenser protection service.



Left — No. 80 "Noiseless" semi-balanced Back Pressure Valve for exhaust lines.



Right — No. 265 Turbine Bleeder and High Pressure Relief Valve.

No power plant valve is more important

In 69 years of specialization on power plant automatic valve specialties, Davis has brought the atmospheric exhaust relief valve to a high point of perfection, with a combination of engineering features not found elsewhere.

Let's look inside the No. 110: The bronze-to-bronze-contact valve is water-sealed through inlet and overflow pipe connections in the body. Valve action is cushioned by a closed-top internal dash pot eliminating sticking of valve due to foreign matter. Flapper valve permits quick opening, slow closing movement. There is full pipe area through the port and all body passages. The valve holds tight under high vacuum, and relieves to atmosphere at a fraction of a pound pressure when vacuum is lost.

Hand lifts, top or bottom, or hydraulic cylinders permit testing the action and holding valve open when desired.

Angle designs available as well as horizontal and vertical, also valves that will function as a relief valve part of the time and back pressure valve at other times, or with hold-open attachment so that valve must be closed manually once it has relieved.

Let us help you on automatic valve problems for steam . . . air . . . gas . . . water . . . and oil.

Ask for ENGINEERING BULLETIN NO. 101A

DAVIS REGULATOR COMPANY

2540 S. Washtenaw Ave., Chicago, Ill.

DAVIS REGULATOR COMPANY

tion of compressed air continue throughout treatment. If compressor capacity is small, allow pressure to build up in the receiver and give occasional short blows.

Start by feeding solution gradually to avoid overflows from "belching" of gas liberated. Cleaning may be considered complete about six hours after gas ceases to evolve if gas evolution is vigorous, as with scale composed chiefly of carbonate. Depending on nature and amount of scale, circulate solution 24 to 48 hr, and where gas evolution is slow continue for full 48 hr. On marine boilers, 72 hr is recommended.

Heavy scale, particularly if hard-baked or semi-vitrified, may require two or more treatments separated by short operating periods. On newly formed scale, a single treatment usually proves adequate.

After treatment, add water until it overflows at top vent, thus displacing all gas. Drain solution completely to sewer, keeping it off concrete floors if possible. Flush system thoroughly with water to remove mud and sludge from displaced and incompletely dissolved scale, which accumulates in system bottom. Finally, add soda ash or trisodium phosphate to the refill water, in proportion of one ounce to one cu ft (7.5 gal).

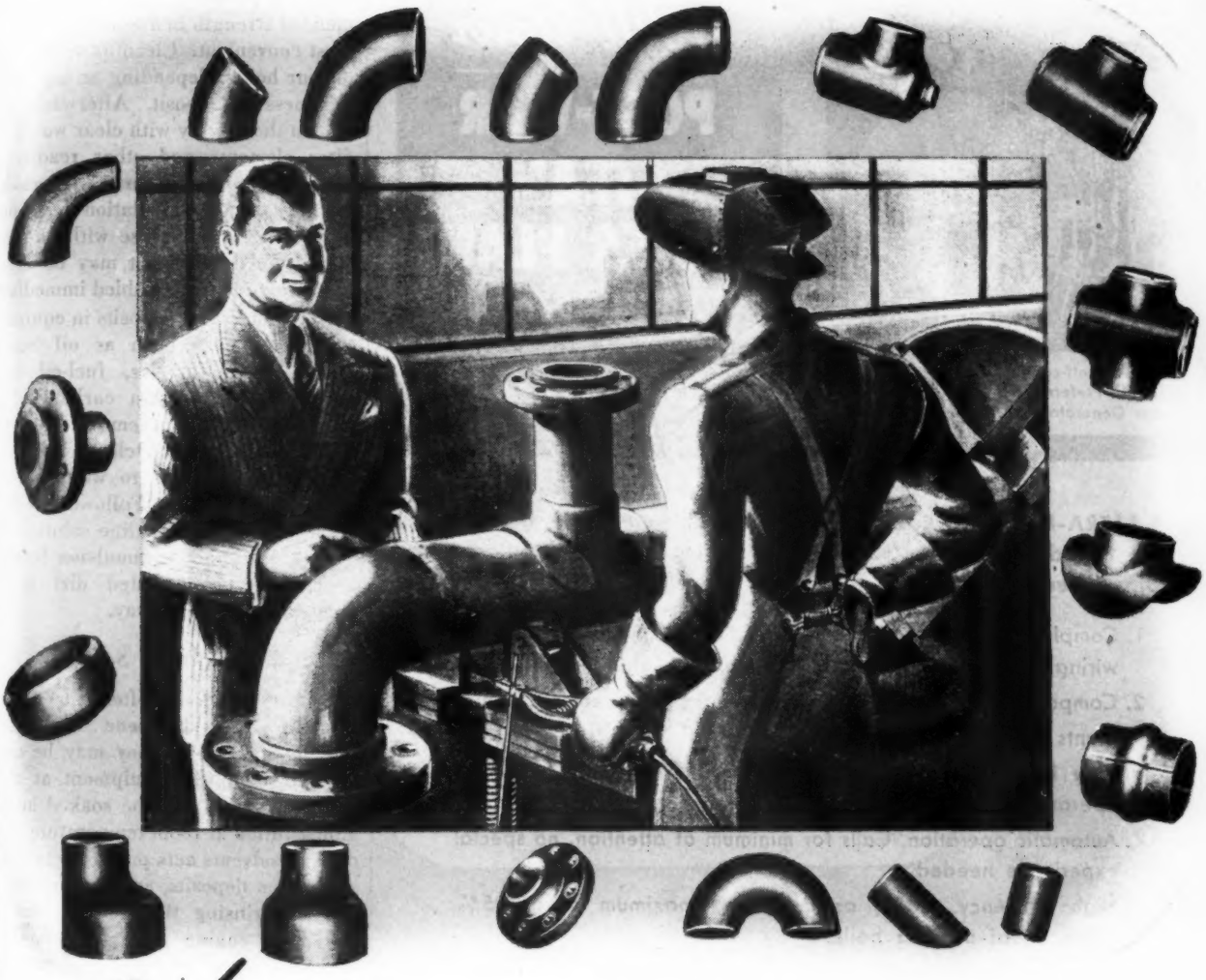
Above procedure applies to boiler scales from all sources except relatively rare cases where calcium sulphate is the major ingredient. If this "gypsum" scale is allowed to form and predominate in the deposit, mechanical cleaning is the only practical solution. If other scales predominate, the acid cleaner's dissolving action often loosens the calcium-sulphate scale as well, and it may be removed.

Alkaline Cleaners

For the other great class of power-plant "dirts"—oily or greasy deposits—alkaline cleaners have long been used and their modern forms still handle a wide variety of jobs. In equipment such as oil coolers, lubricating-oil strainers and filters, deposits consist mainly of emulsified oil, wax and sludge. To remove them, an alkaline cleaner should have an adequate pH but should not be as hard or unpleasant to handle as a caustic. Suitable combination of alkaline salts gives these cleaners better rinsing properties than caustics.

Even modern alkaline cleaners should be handled to avoid splashes and splatters, particularly in the eyes. With alkaline solutions wear rubber aprons, gloves and goggles. Do not throw the material into hot water but stir it in cold water and heat.

For most equipment, circulation of



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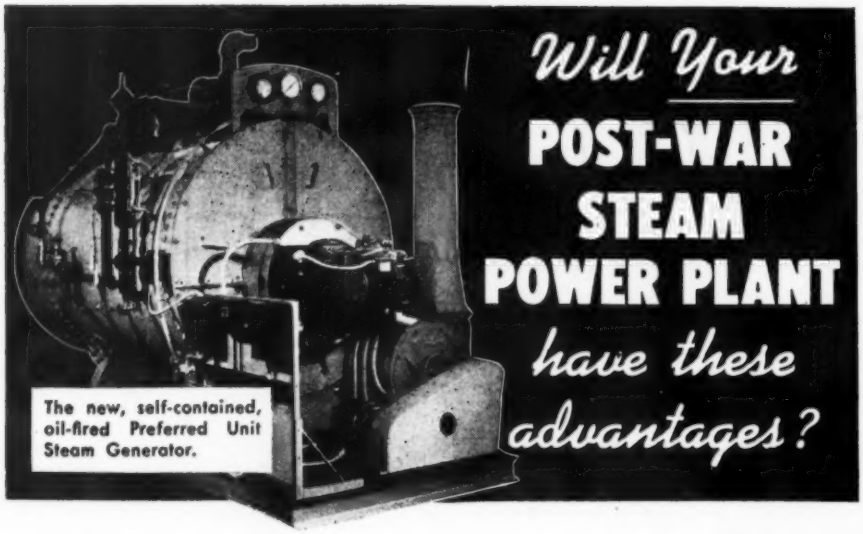

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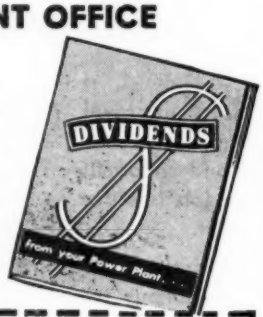

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cleaning solution made up to recommended strength in a heated tank proves most convenient. Cleaning requires one to four hours, depending on nature and thickness of deposit. Afterwards flush system thoroughly with clear water. For filter elements and other readily dismantled equipment parts, immersion in a tank of boiling solution may prove best. Then drain, rinse with hot water and dry. An air blast may be used if parts are to be reassembled immediately.

Oily and greasy deposits in equipment subject to heat, such as oil heaters, burner parts, nozzles, fuel-oil filters and strainers, contain carbonized oil. For speedy, effective removal of carbonized deposits, another cleaner, an emulsifiable solvent, acts to wet, penetrate and loosen deposits. Followed by flushing with a mildly alkaline solution or a good flushing oil, an emulsion forms in which the deflocculated dirt is suspended and carried away.

Emulsifiable Solvents

Such cleaners are often used without dilution or in kerosene solutions of various strengths. They may be circulated through the equipment at about 160 F, or parts may be soaked in suitable solution at room temperature. This class of solvents acts primarily to loosen and soften deposits, and the flushing or pressure rinsing that follows removes dirt. For engine parts carrying hard carbon deposits, brushing may be necessary. Cleaners of this type remove natural oils of the skin, leaving it dry or chapped. Avoid splashing or prolonged contact with the skin.

Emulsifiable solvent cleaners, compounded to work at room temperature in solutions of kerosene or safety solvent, may be used for fast removal of oily and greasy deposits where carbonized oil is not a factor. For example, oil-coated impingement-type air-filter elements may be cleaned by soaking about ten minutes, draining and immersing in hot water. After final draining and drying, they are ready to recoat and return to service. Similarly engine parts with no hard carbon may be soaked in cleaner-kerosene solution from 30 min to 2 hr and finished by draining and pressure rinsing. This cleaner does not attack paints and protective coatings.

Still another cleaner is a neutral soap compounded with a solvent, whose combined action penetrates and loosens the deposit. One application removes hard carbon formations in air-compressor cylinders. Made up into a water solution, the cleaner is injected into the compressor cylinder through the lubricator with the oil supply cut off. Compressor runs three hours with this solution as lubri-

VALUABLE SUGGESTIONS ON HOW TO SELECT THE RIGHT PACKINGS

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- SUGGESTIONS FOR BETTER PACKING PERFORMANCE
- HIGH PRESSURE PACKINGS
- SPECIAL SELF-LUBRICATING PACKINGS
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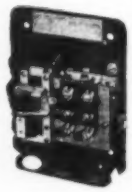
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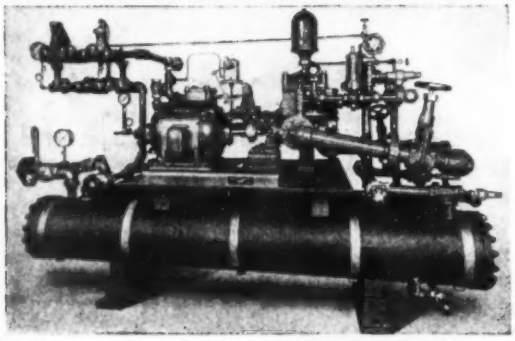

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cant after which lubricating-oil feeding is resumed. The same cleaner, in very dilute solution, is used for many kinds of floor and wall surfaces.

So much for the various cleaners and their application. The table on page 75 lists a large number of equipment items with condensed cleaning instructions. Procedure for equipment not listed can be deduced from data for similar items and similar dirt to be removed. If in doubt, check with a reputable manufacturer of cleaning materials.

The table also lists methods for general operations, such as salvage cleaning, washing walls, floors, etc, and stripping for repainting. Most salvage cleaning can be done with heavy-duty alkaline cleaners in a boiling solution. For extensive work, construct cleaning and rinsing vats large enough to handle standard pipe lengths. Perforated-metal or heavy-wire baskets are convenient in handling parts from one vat to another. If parts are badly rusted or scaled, treat with an inhibited-acid cleaner.

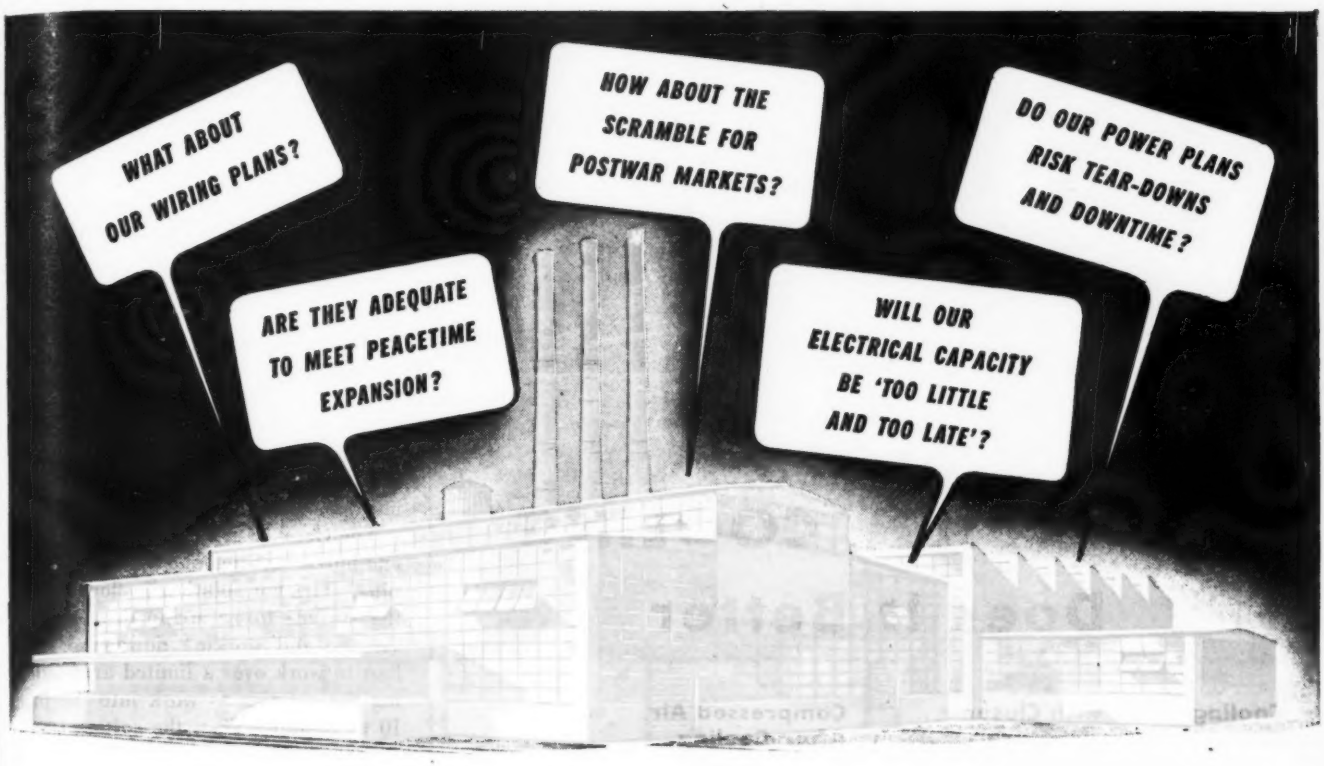
Rustproofing for Storage

When clean parts are well dried, it is advisable to protect them against rust during storage. This is most easily and effectively done with a protective film which sets permanently within 24 hr. A concentrate, it is mixed with safety solvent or V & M P naphtha, one part to three of solvent. Applied by brushing, dipping or spraying, it dries to an indefinitely safe, dry, non-greasy surface and assures complete anti-rust protection when parts are stored indoors.

Commonest floor surfaces in power plants are cement and steel grating. For cement, select cleaners carefully because the wrong cleaner not only gives poor results but materially shortens floor life. The cleaner must combine controlled alkalinity and penetrating power with effective wetting action so the solution can penetrate deeply into oily and greasy deposits, breaking the bond between cement surface and dirt and flushing it away with relatively little need for brushing and scrubbing. An effective cement cleaner may also have ability to whiten and harden the cement.

Sprinkle cleaners of this kind, readily soluble solids, lightly over a 10-sq-ft area of wetted cement. Brush lightly with a heavy bristle brush, working the material into the dirt with water. A few minutes brushing does the job on normally dirty floors. Follow by hosing or brushing off with clear water.

Keeping grating, steps and ladders clean and free of oily deposits helps insure underfoot safety. Clean them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ARE THEY ADEQUATE TO MEET PEACETIME EXPANSION?
HOW ABOUT THE SCRAMBLE FOR POSTWAR MARKETS?
WILL OUR ELECTRICAL CAPACITY BE 'TOO LITTLE AND TOO LATE'?
DO OUR POWER PLANS RISK TEAR-DOWNS AND DOWNTIME?

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Foresighted market surveys won't mean much if plant wiring and service equipment capacity don't back up potential volume.

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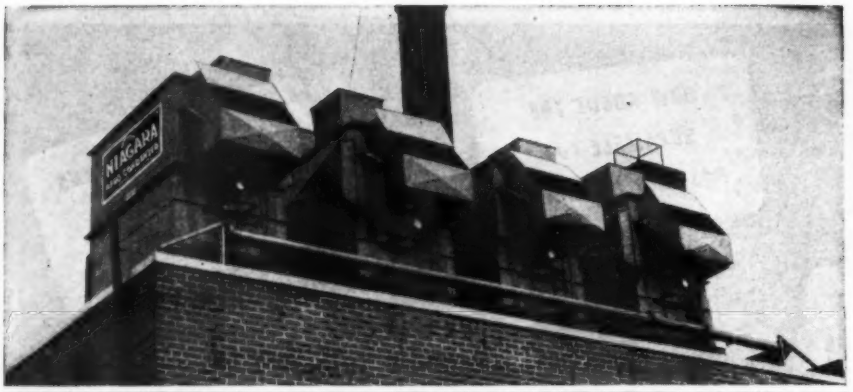

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with an emulsifiable solvent cleaner in a kerosene or safety-solvent solution. Spray or brush on the cleaner, and after soaking about 15 min flush away with a water hose. Surfaces so cleaned may be repainted without further treatment. Cleaner has no harmful effect on painted surfaces. For quick drying, hot water may be used for flushing off but it is not necessary for cleaning.

Heavy-duty alkaline cleaners are well suited to stripping paint from various kinds of equipment, providing a more penetrative and less alkaline solution than the former strong caustics. It strips off paint in comparatively large flakes and so loosens the coating that high-pressure steam or water can remove it.

The October article described a tank-and-nozzle arrangement for the stripping. The hot solution is flowed on to the surface to be stripped, starting at the top and working downward. It is best to work over a limited area, allowing the solution to work into the paint 10 to 20 min. Then the softened paint is flushed off with a steam jet or stream of high-pressure water. When the entire surface has been stripped, it should receive a thorough final water rinse, making sure no traces of unrinsed cleaner remain to affect the bond of the new paint job. One application will strip about three coats of paint. Thicker layers call for additional applications.

Often it is desirable to thicken the stripping solution to hold it on vertical surfaces long enough to insure effective stripping action. This is readily done by stirring in a little cornstarch paste (1 lb per gal of solution).

Ultimate Analysis

(*Continued from page* 91)

received. Items in column (d) should total 1.000, or very nearly so.

Table 1 summarizes a number of calculations involving coals from various coal-producing areas. It includes two coals, Alaska (1) and Kentucky (1) whose carbon varied widely from the curve in Fig. 3. Except for these two coals, picked deliberately for their exceptional divergence, the coals reported show fairly close agreement between the calculated and actual ultimate analyses on an as-received basis.

Now, what is the final effect of a difference of 5.84% carbon in the case of Alaska (1) and 7.08% carbon in the case of Kentucky (1)? To check this, combustion calculations were made for

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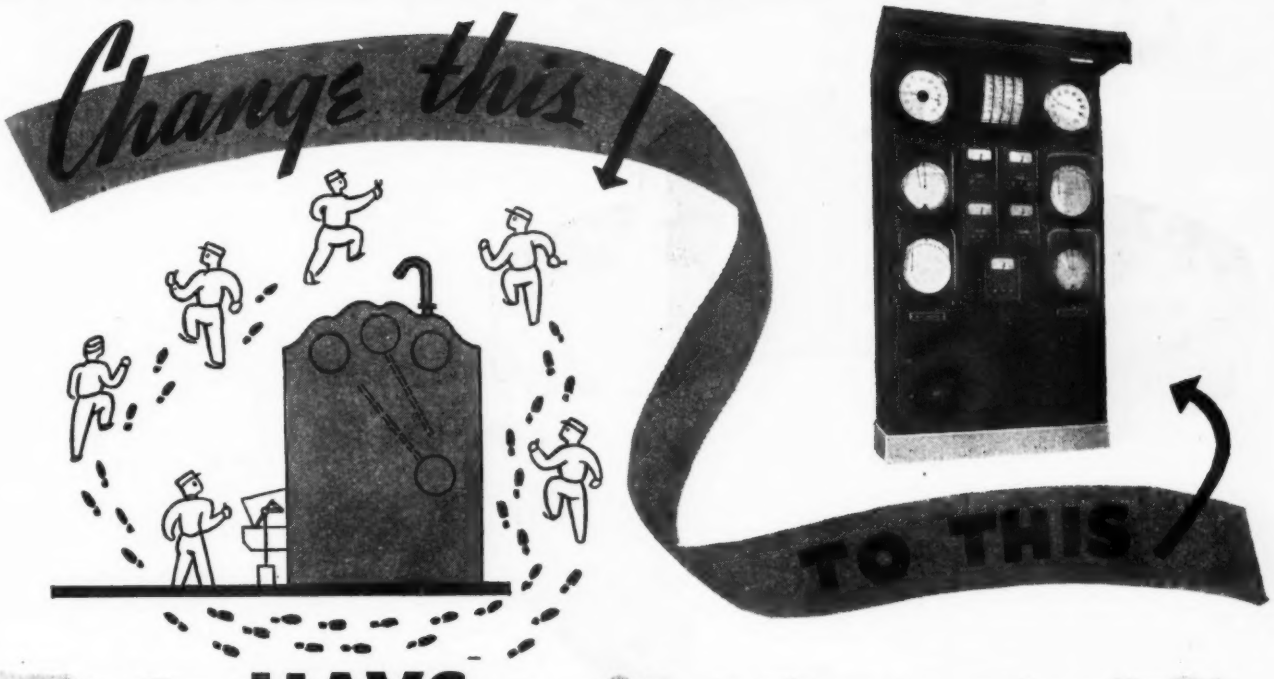

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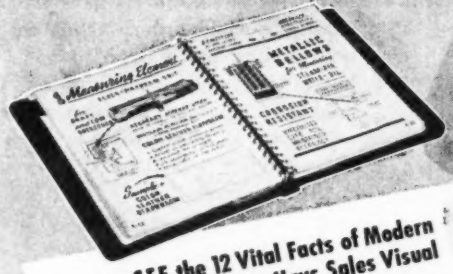
LOOK at the steps necessary in manual operation of a steam plant—to adjust boiler dampers, air distribution, fuel feed, fan dampers—not to mention a dozen routine duties of operating, inspecting, maintaining.

Now look at the Hays Combustion Control method—orderly, harmonious, automatic, measures every variable accurately; translates every need for adjustment into operating impulses; transmits these impulses to the power units that make the adjustments: all done instantly—a complete and effective coordination whose advantages are accuracy, sensitivity, speed and power.

You get far more efficient combustion with this simple, well engineered, dependable method—save incalculable man-hours, save fuel, save important money. It's good business to *see* how it can help you by seeing the Hays Visual Presentation. A Hays representative will show it to you—and a line to us makes the contact.



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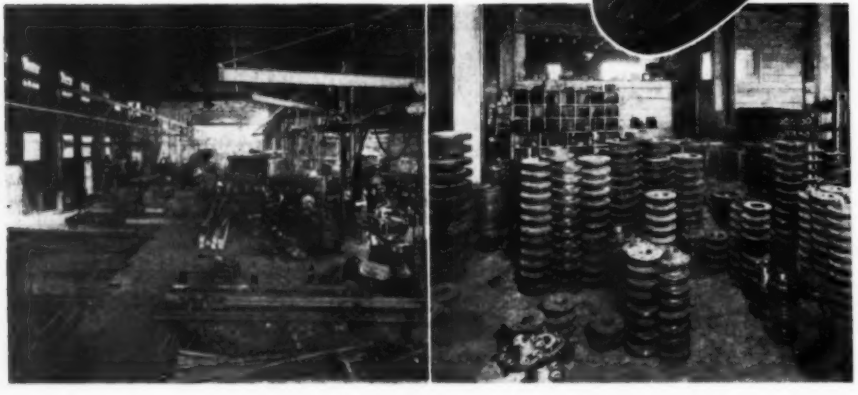


both coals using the actual as well as the calculated ultimate analyses. Table II gives the results.

The proof of the usability and accuracy of any method for making calculations, particularly those involving empirical data, lies in the results obtained. For most fuels, the calculated ultimate analysis is reasonably accurate. In those instances where considerable divergence between actual and calculated ultimate analyses occurs, the tendency is for the calculated ultimate analysis to give a greater weight of theoretical air for combustion than does the actual ultimate analysis.

Power News

(*Continued from page* 130)

tricts 1, 2, 3, 4, 5, 6 and 13, and those who buy *high-volatile* coal from districts 7 and 8, may buy 100% of their monthly burn when they have 35 days' supply on hand. Those receiving coal by rail and holding 36 to 50 days' may buy monthly an amount not in excess of that required to reduce stocks to 35 days at end of month for which order was placed. Utilities holding more than 50 days' may buy 50% of their monthly burn. Those holding 21 to 34 days and receiving by rail may buy 105% of their burn, and those holding less than 21 days 110%.

Utilities receiving directly from tidewater and holding 45 days' supply may buy their monthly burn. Those holding 46 to 60 days' supply may buy an amount not in excess of that required to reduce stocks to 45 days' at end of month for which coal was ordered. Utilities holding 30 to 44 days' may buy 105% and those holding less than 30 days' may buy 110% of their burn.

With a 25-day limit on stocks of *low-volatile* coal bought in districts 7 and 8, utilities who receive by rail and hold 26 to 40 days' may buy an amount not in excess of that required to reduce stocks to 25 days' at end of month for which coal was ordered. Those holding 16 to 24 days' stocks may buy 105% of their burn and utilities holding less than 16 days may buy 110%.

Tidewater receivers of *low-volatile* from districts 7 and 8 may buy 100% of their burn if they have 35 days' supply. Those holding from 36 to 50 days' may buy not to exceed that amount which will bring their stocks down to 35 days' at end of month for which it was ordered. Holders of more than 50 days' supply may buy only 50% of their burn. Those holding 21 to 34 days' may buy

★ GUIDES AND CONTOURS

TWO FEATURES OF VALVE DESIGN AND MANUFACTURE THAT ARE ALL-IMPORTANT

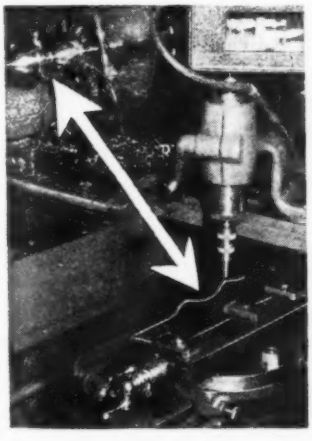
Simple perhaps — but nevertheless true that the difference between **EXCELLENT** and **JUST FAIR** performance of diaphragm control valves is *the guiding and contouring of the inner valve.* These all-important features as perfected by Fisher spell "extreme satisfaction with performance capable of continuously meeting specified operating conditions."

STEM GUIDING . . .

Sound engineering design, careful selection of materials and accurate machining and alignment on Fisher valves prevents sticking or seizing conditions and resultant sluggish operation and valve breakage.

All Fisher diaphragm control valves, using plug type inner valves are equipped with renewable screwed-in top and bottom guide bushings of stainless steel or other special metal best suited to the service encountered. Bushings are hardened or stellite faced where necessary to resist excessive wear. Close machine tolerances and accurate alignment are production features that further assure dependable, trouble-free performance.

CONTOUR MACHINING . . .



Fisher plug valves are designed and thoroughly tested to provide certain specific flow characteristics. Inasmuch as the curvature of the surface of these valves controls the rate of flow, it is obvious that the flow obtained in actual performance is a function of *accuracy of machining* the contour surface.

All plug valves used in Fisher control valves are machined from forgings or bar stock on latest model automatic template type machines that assure extremely accurate contours to within .001 inch. These automatics also insure absolute uniformity for all plug valves of a specific size and contour design. Accuracy and uniformity guarantee field performance in exact accordance with published specifications and flow charts.

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Pyrex Gauge Glasses

105%, and those holding less than 21 days' may buy 110%.

In addition to reducing standard stockpiles (those at which full monthly burn may be ordered) amendment lops five days off margin given to tidewater receivers last year, leaving it at ten days.

Another amendment directed producers who are unable to fulfill their commitments to ship first to industrial users, including utilities, who have less than 15 days' supply.

New stock limitation table was opposed by Office of War Utilities on two counts, but was instituted by SFAW because of severity of supply situation. OWU argued that any electric utility which must operate with less than 30 days' supply is in a dangerous position and also that limiting of utility purchases to a maximum of 110% of monthly burn prevents rebuilding of depleted stocks in quickest possible time. It asked that utilities with less than 30 days' supply be allowed to build to that level immediately and that industry be granted a preference which would allow it to maintain 30-day supplies.

In general, it was conceded, utilities had more than the new standard stockpiles on Jan 1, but period of freezing weather that followed delayed deliveries and in some cases halted production for want of empty cars to fill at the mine, thus lowering industry's average supply. Numerous plants have had their boiler capacities lowered by frozen coal. Other firms which have tried to collect coal from broad base of a coal pile whose top has been removed and not replaced have experienced difficulty in obtaining manpower and tools to gather the coal.

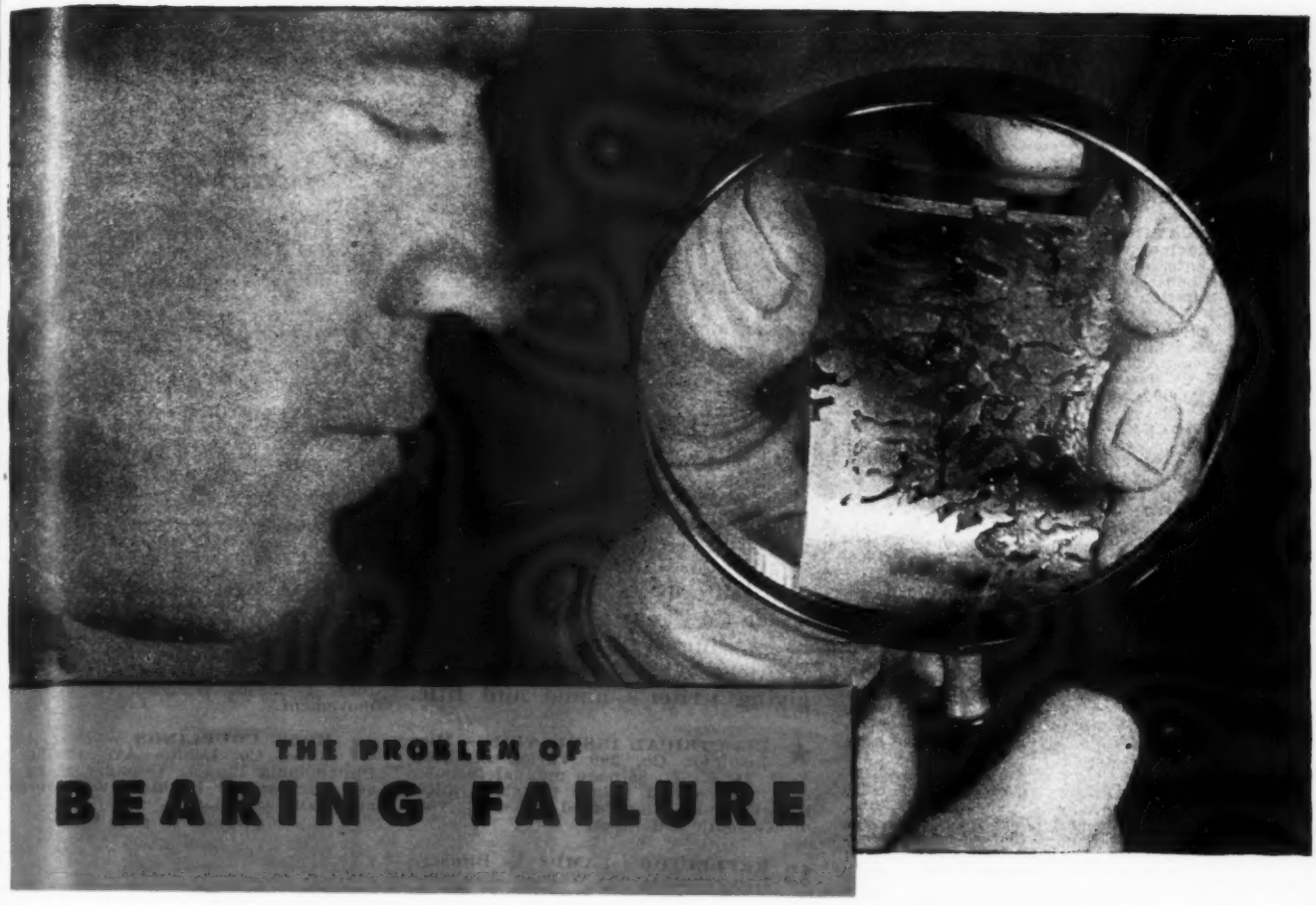
SFAW ordered that all contracts for Lakes shipments this year had to be filed by Feb. 20. Its order also made stringent reductions in amount of stockpiles which users in territory supplied over Lakes may have.

New Coal Reserves Help Relieve Alaskan Shortage

Exploratory work of Bureau of Mines has added 1,656,700 recoverable tons of good-grade bituminous coal, valued at about $8,300,000, to Alaska's known reserves of solid fuels, and further search now under way should disclose additional deposits. Coal already explored is in Moose Creek district of Matanuska area, near the colonization project. New reserves total 2,375,500 tons, but 718,800 tons are not considered recoverable.

This discovery is helping ease an acute fuel shortage in the Territory and is saving shipping space from states for other essential materials to serve in defense and development of region. New reserves are

(*Continued on page* 188)



THE PROBLEM OF BEARING FAILURE

SUCH THINGS as load, speed and temperature have a very material effect on the life of automotive bearings. Sometimes bearing failures are caused by dirty lubricating oil. When the oil is contaminated with water, fuel, sand, dirt, carbon particles or finely divided metal, excessive wear in the bearings results. Present day driving conditions which tend to create low temperature sludge, clog oil lines and screens and result in burned out bearings.

A great many bearings are ruined by overloading (lugging) and overspeeding the engine; by such driving habits as the prolonged use of the engine as a brake in low gear, down long grades; continuous driving at top speeds; failure to shift gears on hard pulls.

WHY BEARINGS FAIL

1. FATIGUE FAILURE: Due to several causes. Among them: overloading; overspeeding; deflections of crankshaft; insufficient oil clearance or stoppage of oil supply; distortion due to poor fit of bearing inserts; out-of-round crank pins and crankshaft journals. As a result of fatigue failure, the bearing metal cracks and flakes out, the rod portion of the bearing failing first, then the bearing cap.

2. WEAR FROM DIRT: The result of infrequent draining and flushing of the crankcase or infrequent servicing of the air and oil bath cleaners.

3. WIPING: Friction heat often causes the bearing metal to melt and run, or to become soft and plastic. This in turn allows the bearing metal to wipe or smear against the harder metal surfaces of the crank pin or bearing journal, cracking and wiping the bearing metal. The causes for this failure are: lack of oil; plugged oil passages; clogged pump screen; worn oil pump; leaky oil pump suction line; broken oil lines or connections; misfit bearings.

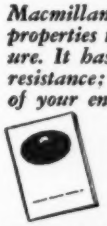
4. CORROSION: Prolonged high speed driving and overloading will produce crankcase oil and bearing temperatures above 250° F. in most late model engines. At such temperatures most lubricating oils are subject to oxidation and consequent production of organic acids that are corrosive to bearing metals. The remedy is to use lubricating oils that won't readily form corrosive acids and to drain and flush crankcases frequently.

WATCH DRIVING AND SERVICING

To avoid bearing trouble, don't overload; don't brake with the engine for prolonged periods of time; don't use all your horsepower any more than you have to. Have your engine serviced at more frequent and regular intervals. Use only the best lubricating oil obtainable.

RING-FREE MOTOR OIL HELPS PREVENT BEARING FAILURES

Macmillan Ring-Free Motor Oil has the properties that guard against bearing failure. It has high film strength; high heat resistance; a long cling to the vital parts of your engine; fast penetration. It has a cleansing action that washes away carbon particles, carrying them into the crankcase where these impurities are drained at time of oil change.



FREE FOLDER *on "Bearing Failures—Causes and Corrections"*—Send today for your copy. Address Macmillan Petroleum Corporation, Room 1013, 530 West Sixth Street, Los Angeles 14, California

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AIR CONDITIONING, HEATING REFRIGERATION AND VENTILATING

1 **HEATING COILS**—Modine Mfg Co., Racine, Wis. 20-page catalog No. 345 presents new line of copper blast heaters and booster units. Piping diagrams and installation suggestions are included.

2 **REFRIGERATING MACHINES** — Worthington Pump & Machinery Corp, Harrison, N. J. 8-page bulletin No. C-1100-B8 describes operation of Worthington absorption refrigerating machines.

3 **COOLERS**—Worthington Pump & Machinery Corp, Harrison, N. J. 8-page bulletin No. C-1100-B17 discusses cooler designs for mechanical refrigeration.

4 **CARBON-DIOXIDE PLANTS**—Worthington Pump & Machinery Corp, Harrison, N. J. 8-page bulletin No. C-1100-B24 furnishes data on complete carbon-dioxide plants for the production of carbon dioxide, gas, liquid and dry ice.

BOILERS AND AUXILIARIES

5 **LIGHTWEIGHT REFRACTORY** — A P Green Fire Brick Co, Mexico, Mo. 24-page booklet, entitled "A Guide to the Uses and Advantages of Insulating Refractory Castable," gives informative data on Kast-O-Lite.

6 **OIL AND GAS BURNERS**—Peabody Engrg Corp, 580 Fifth Ave, New York 19, N. Y. 4-page bulletin No. 902 describes Peabody Type M gas burner and the combined gas and oil burner.

7 **SECTIONAL WALLS**—Geo P Reintjes Co, 2517 Jefferson St, Kansas City, Mo. 1-page bulletin outlines principles underlying Reintjes sectionally supported walls.

COMPRESSORS AND ACCESSORIES

8 **GAS-ENGINE COMPRESSORS**—Worthington Pump & Machinery Corp, Harrison, N. J. 24-page bulletin No. L-685-B1 gives engineering details of LFC angle four-cycle gas-engine compressors.

9 **ROTARY COMPRESSORS** — Motoair Div, N. J. Machine Corp., 1505 Willow Ave, Hoboken, N. J. 6-page bulletin covers construction features and specifications of Motoair pumps for vacuum or pressure.

10 **GAS-ENGINE COMPRESSORS**—Ingersoll-Rand Co, 11 Broadway, New York 4, N. Y. 14-page form No. 3081 describes KVG 4-cycle V-angle gas-engine-driven compressors.

ELECTRICAL EQUIPMENT

11 **TEST CLAMPS**—Trico Fuse Mfg Co, Milwaukee, Wis. 1-page bulletin No. 7 discusses test clamp line, with solder or solderless lugs attached, for making heavy-duty temporary connections, motor and meter testing, jumpers, cable and busbar taps, battery charging, welding, etc.

12 **GEAR-MOTORS** — General Electric Co, Schenectady, N. Y. 16-page booklet No. GEA-1437D contains information on integral- and fractional-horsepower gear motors for low-speed drives. Equipment photographs are included.

All literature designated with a star (★) may be obtained only by writing direct to the manufacturer on company letterhead, giving writer's name and title.

★ **ELECTRICAL INSULATION**— Mica Insulator Co, 200 Varick St, New York 14, N. Y. 86-page manual includes data, tables and values on sheet mica, built-up mica, laminated plastics, varnished cloth and tapes.

13 **REFLECTOR LAMPS** — Birdseye Lamp Sales Div, Wabash Appliance Corp, 345 Carroll St, Brooklyn 31, N. Y. Booklet No. 1-545 on reflector lamps features a set of charts containing illumination values based on various spacings and mounting heights.

14 **SQUIRREL-CAGE MOTORS**—Crocker-Wheeler Div. Joshua Hendy Iron Works, Ampere, N. J. 4-page booklet No. DL-121 gives features of protected-type motors.

15 **CONNECTING DEVICES** — Howard B Jones Co, 2460 W George St, Chicago 18, Ill. 32-page catalog No. 14 describes complete line of multicontact plugs and sockets, terminal strips, fuse mounts, etc. Dimensions of items are included.

PIPING, FITTINGS VALVES AND SPECIALTIES

16 **FLOAT VALVES**—Clayton Mfg Co, Alhambra, Calif. 8-page catalog No. FV11(145) discusses float-valve line for direct or remote control, together with a few of many application suggestions.

17 **PIPING TEMPLATE**—W H Nichols, 1055 W Granville, Chicago 40, Ill. Folder presents new machine-cut celluloid template for rapid and accurate drawing of piping layouts.

18 **PREFABRICATED PIPING** — Alco Products Div, American Locomotive Co, 30 Church St, New York 8, N. Y. 14-page bulletin No. 1034 covers prefabricated piping, pressure vessels, fabricated plate work and heat-exchange equipment.

19 **WELDED TUBING** — Formed Steel Tube Institute, Cleveland, Ohio. 24-page booklet shows how tubing as a basic material has been fabricated and adapted to peacetime and wartime products.

20 **TUBE FITTINGS**— Imperial Brass Mfg Co, 1200 W Harrison St, Chicago 7, Ill. 16-page catalog No. 344 describes Flex fittings for connecting tubing where there is major vibration or minor tube movement.

21 **HOSE COUPLINGS** — Hose Accessories Co, Lehigh Ave at 17th St, Philadelphia 32, Pa. 48-page catalog No. 644 discusses Le-Hi high- and low-pressure hose couplings.

(*Continued on page* 186)

HOW TO ORDER

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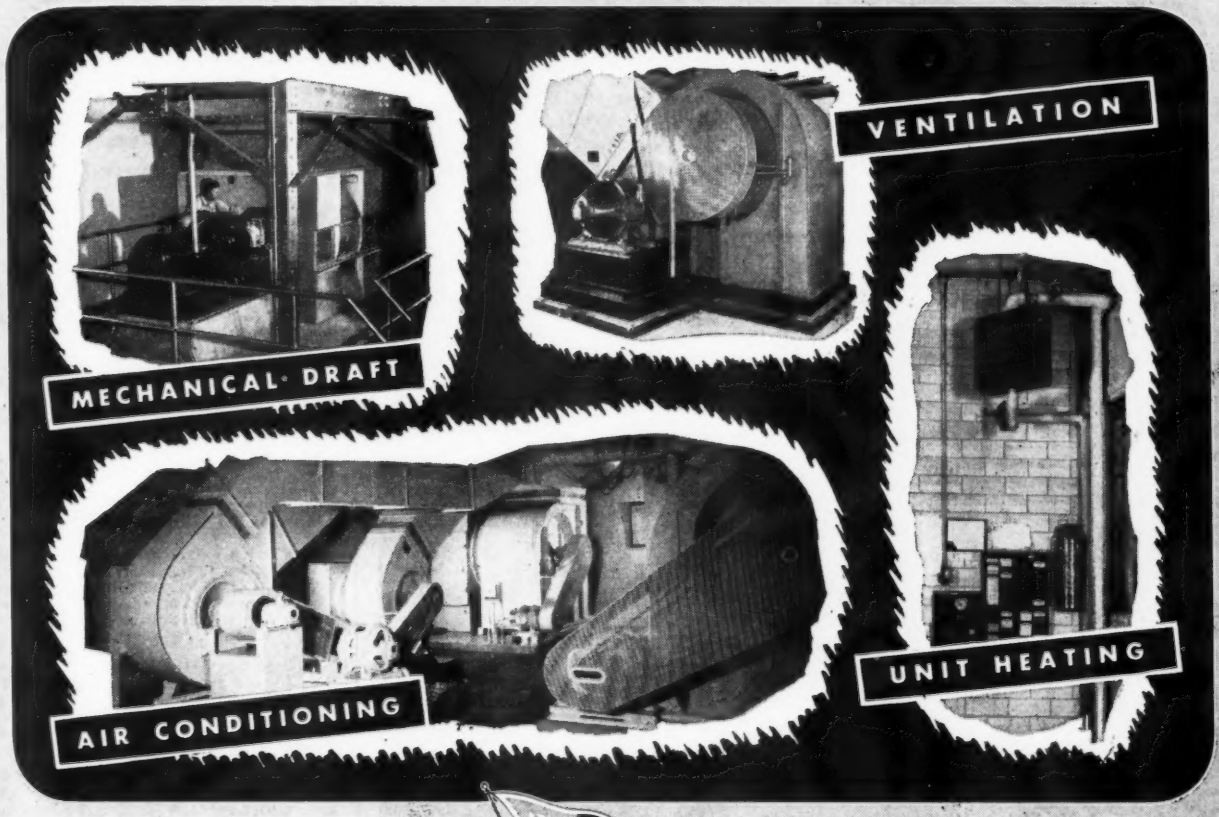

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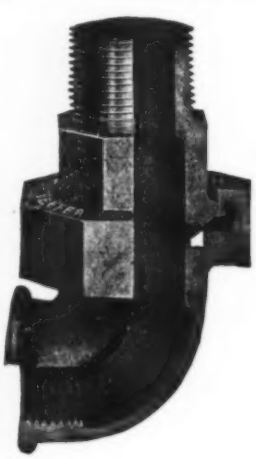

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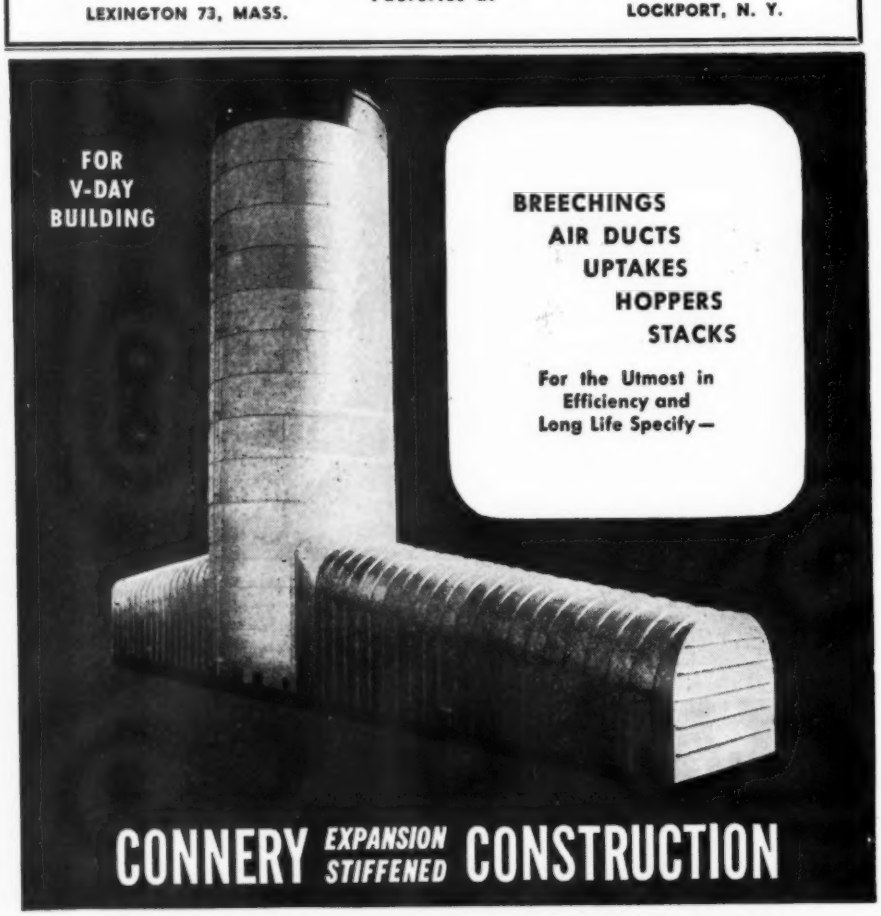

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New Bulletins

(*Continued from page* 184)

PUMPS

22 SCREW PUMPS—Pump Div, Sier-Bath Gear Co, North Bergen, N. J. 24-page gives features of Sier-Bath screw pumps for consideration when making selection of pumping equipment.

23 MATERIAL PUMPS — Alemite Div, Stewart-Warner Corp, 1826 Diversey Parkway, Chicago, Ill. 8-page form No. 22-223 presents Versatal pumps for dispensing and applying paints, lacquers, mastic, sealers, insulating materials, etc.

24 PUMPS—Bump Pump Co, LaCrosse, Wis. 104-page catalog describes Bump pump principle of operation. Sizes, dimensions, hp charts, installation diagrams, etc, are included.

OTHER EQUIPMENT

25 FIRE EQUIPMENT — American-La-France-Foamite Corp, Elmira, N. Y. Illustrated folder discusses various foam applicators made available by government release of aluminum.

26 MECHANICAL PACKINGS—Anchor Packing Co, Philadelphia, Pa. 137-page catalog gives manufacturing service facilities, selection of proper packings, suggestions for better packing performance, types of packings, etc.

27 VENEER COATING — Paint-Point Corp, 99 S 6th St, Brooklyn, N. Y. 1-page sheet presents Renewall, a ready-mixed veneer coating for concrete, brick and stucco exteriors.

28 ASH DISPOSAL SYSTEMS—Chicago Fire Brick Co, 1419 N Elston Ave, Chicago 22, Ill. 4-page bulletin No. 1244 discusses operation of Durabilt automatic ash disposal systems.

29 V-BELT DRIVES — Allis-Chalmers Mfg Co, Milwaukee 1, Wis. 12-page catalog No. B6051E includes list prices, stock sizes, dimensions and construction details for all Texrope drives.

30 FLEXIBLE COUPLINGS — Ajax Flexible Coupling Co, Westfield, N. Y. 24-page catalog gives parts, hp ratings, service factors, types, etc. of Ajax flexible couplings.

31 VIBRATION-MEASURING EQUIPMENT—General Electric Co, Schenectady, N. Y. 8-page bulletin No. GEA-4140 explains operation of vibration-measuring instruments. Equipment features and specifications are included.

32 CONDENSER TUBE INLETS—Condenser Service & Engrg Co, 95 River St, Hoboken, N. J. 8-page bulletin presents Flowrites, short belled-end metal inserts which protect condenser tube inlets against erosion.

33 BLACK-AND-WHITE PRINTS—Charles Bruning Co, 4700 Montrose Ave, Chicago 41, Ill. 32-page booklet deals with Bruning BW process for making black-and-white prints, as distinguished from blueprints.

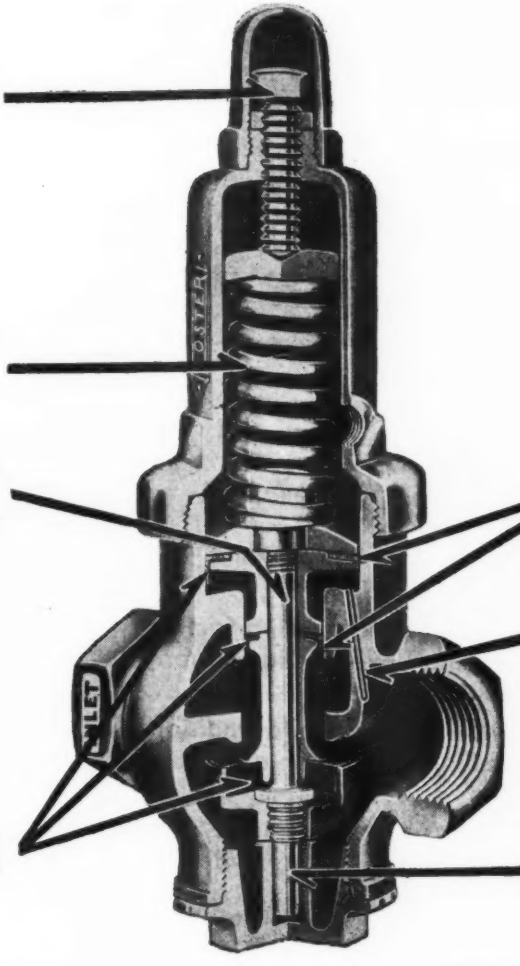
34 OPEN FLOORING — National Machine & Foundry Co, 315 6th Ave, Pittsburgh 22, Pa. 8-page bulletin describes Prestoweld grating, including flooring and stair treads.

Because of its faith in postwar growth and prosperity of Detroit and southeastern Michigan, Detroit Edison Co intends to spend $125,000,000 during the ten years after the war to keep pace with demand for electricity in the area. One of first items of postwar construction is a new 75,000-kw 100,000-hp turbine-generator now on order, but held up for many months by need of materials for war industries.

FOSTER REGULATION ENGINEERING

Saves Maintenance Time

for example, **in this direct-acting valve for water or air services, the Foster Type U gives you regulation without complication.**



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2 Springs "flexible" cadmium plated

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Foster Type U, Spring-loaded Direct-acting Reducing Valve for Water and Air Service

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- **Exceptional anti-friction properties . . . becomes a smooth, bearing-like sleeve in service.**
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This Palmetto Packing has ultra-high resistance to friction and heat. It does not dry out or harden—no liquid lubricant to be squeezed out or melted.

Derives its lubricating properties from *graphite* and soft flakes of anti-friction *bearing metal*, which form a wearing surface of low friction.

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adjacent to Buffalo coal mine, an active operation. This mine and others in Matanuska coal field have produced about 150,000 tons annually, but they should be able to double their output and thus supply three fifths of Alaska's annual needs of 500,000 tons.

While of poor coking quality, Moose Creek coal is best bituminous produced commercially in Alaska and is popular for both domestic and commercial uses. It is high-volatile B bituminous, possesses good heating value, stores well without slacking, and its low moisture and sulphur content reduce spontaneous combustion danger.

DEMA Guides Instructors Through Western Plants

Close-up of diesel engine manufacturing on the Pacific Coast was shown Feb 8 to engineering instructors of Western universities assembled in San Francisco for a tour through the Bay area. Ninety-six percent of the country's output of diesel engines west of Mississippi River is in the Bay area, where an estimated 500,000 hp in diesels was manufactured in 1944, to a valuation of some $50,000,000. Tour included trips through Enterprise Engine & Foundry Co. of San Francisco, and Atlas Imperial Diesel Engine Co and Union Diesel Engine Co, of Oakland.

In a discussion period, educators told how the manufacturers could help them by providing films, slides, literature and engine parts for classroom instruction. The manufacturers then described the graduate who is best equipped to enter diesel industry.

Among those representing the manufacturers were Charles G Cox, vice-president of Enterprise, and Roy A Hundley, chief engineer; F H Kilberry and G F Twise, president and vice-president of Atlas; and O H Fischer, president of Union.

California universities, which had been invited to send representatives, are Stanford, Santa Clara, University of California, California Institute of Technology and University of Southern California. Invitations were also sent to University of Idaho, University of Washington, University of Nevada, State College of Washington and Oregon State College.

The more you GIVE
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1945 RED CROSS WAR FUND

SOME INSIDE BOILER FACTS

The interior surfaces of this high pressure boiler have been coated with tough, durable, APEXIOR No. 1

The next time your boiler is down, compare how it looks with this one

When you coat the interior metal surfaces of your boiler with APEXIOR, here's what happens:

1. A film of safety seals the open structure of the boiler metal. This film of safety is corrosion-proof because it is non-metallic, therefore the present condition of the boiler steel is improved and maintained.
2. Dirt and scale do not adhere as tightly to APEXIOR as to bare metal, because any bond between scale-forming solids and APEXIOR is easier to break, as it is a purely mechanical, not a chemical bond.

APEXIOR NUMBER 1 is brush-applied, manually or by power-coater. High boiler pressures or ratings, or chemical treatment of boiler water, do not affect APEXIOR NUMBER 1. The total thickness of the coating is .0025". Heat transfer is not retarded.

Recommended by Insurance Companies

APEXIOR NUMBER 1 is recommended by boiler insurance companies. Steam turbines are being delivered to users with shafts and rotor bodies APEXIORIZED. The supplier of your turbine may be one of those following this procedure of added protection.

So when you're thinking in terms of higher production and maintenance standards, start with the heart of your plant, your boiler. APEXIORIZE it.

For "Cold-Wet" Metal Surfaces— APEXIOR No. 3

Wherever you have tanks or metal surfaces exposed to water or moisture at any temperature under 125°F.—protect them with APEXIOR NUMBER 3. This special, shiny-black paint on metal is resistant to cold water, fresh or salt.

Organizations like these have used* APEXIOR *for years

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protective coatings for
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Troubled with FIRE-SCALE and SOOT?

Use XZIT

FIRE-SCALE AND SOOT ERADICATOR

Today, few power plants can afford to waste time and labor to remove fire-scale and soot by old manual method. Xzit reduces these fuel-wasting deposits chemically, so they may be dissipated automatically by natural draft or blowing.

By simply feeding it into the fire-box while the boiler is in operation, Xzit keeps heating surfaces clean, reduces blowing, maintains uniformly higher boiler temperatures and lower stack temperatures, and reduces maintenance.

Write for Xzit sample or demonstration in your plant.

XZIT SALES CO.

1031 Clinton St., Hoboken, N.J.

Diesel Builder Host to Educators

In the first of several meetings in diesel-engine manufacturing plants, sponsored by Diesel Engine Manufacturers Assoc as part of its educational program, Nordberg Mfg Co was host to a group of department heads of midwest engineering schools. Purposes of the meeting were to: (1) acquaint heads of engineering schools with facilities of Nordberg for diesel manufacture (2) note recent progress made by diesel engines in meeting wartime needs (3) learn of postwar plans and developments (4) understand better the needs of diesel manufacturers for competent engineering graduates to work on design, testing and development.

The morning was devoted to an inspection trip through the plant to observe machining and assembling operations and testing of completed engines.

At a noon luncheon, guests, together with Nordberg executives, were greeted by Robert E Friend, president. Short addresses were also made by C E Stryker and E C Bayerlein, vice-presidents, the latter covering history and achievements of Nordberg gleaned from his more than 50 years of association with the company. Another interesting, informal address covered diesel experiences of Jean Santschi, superintendent of installation, going back over a span of 42 years. Before coming with Nordberg in 1915, he was engaged in diesel work in Europe and there had the opportunity to meet Dr Rudolph Diesel.

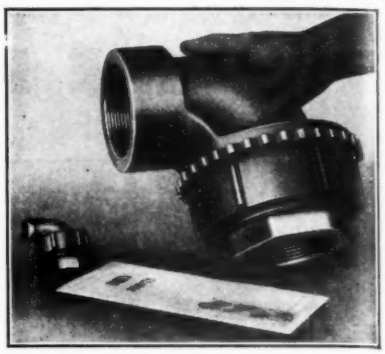
Educational Session

At the afternoon session, the educators saw a display of educational material consisting of films, slides and engine parts prepared by Nordberg for diesel training in the two plant schools conducted by Navy and U. S. Maritime Commission. This meeting was addressed by Emil Grieshaber, chief engineer, who spoke on "The Type of Engineer I Would Like to Hire in My Department." He emphasized not only the need of creative ability but also opportunities that the diesel offered. In outlining a well-balanced program of student training he told how it would serve in developing the type of diesel engineer needed.

This session was also addressed by Prof R B Rice, educational consultant for DEMA. He discussed various ways in which the school and diesel builder can cooperate in proper training of engineers.

The evening session as well as the other sessions were conducted by R W Bayerlein, sales manager, heavy machinery div, Nordberg, who is a member of Educational Committee of DEMA. Principal address of the evening was made by Harvey Hill, executive director of DEMA, who outlined the rapid growth of diesel engine and the part it plays in war effort.

Each diesel company represented was called on for a few remarks on current developments and how their particular engines fit into the postwar picture. Responses were made by Robert E Friend, Nordberg Mfg Co; Henry Barbour, Fairbanks, Morse & Co; J E De Long, Waukesha Motor Co; Harold Hill, Lister Blackstone, Inc; W J Kahlenberg, Kahlenberg Bros; E L Horst, Murphy Diesel Engine Co.



1/4 inch to 3 inch

FLEXO JOINTS

are made in all standard iron pipe sizes from 1/4 inch to 3 inches with screwed female ends. Special threads can be furnished to order. Ruggedly constructed for long, hard service for all pressures up to 1350 lbs superheated steam.

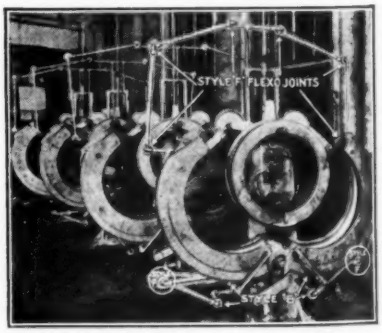
Use FLEXO JOINTS wherever a flexible or swing joint is required for conveying steam, air, water, oil, gas or other fluids through pipe lines that are moved or swung in different directions or to supply machinery or equipment with any fluid while in motion. Any desired pipe line flexibility can be obtained by using a combination of the 4 styles of FLEXO JOINTS—illustrated below.

Style "A"

Style "B"

Style "F"

Style "H"



Full molded inner tube vulcanizers. The movable mold sections are supplied with a uniform and dependable steam pressure by using FLEXO JOINTS.

No matter how hard the service may be the uses for FLEXO JOINTS are limited only by the applications to which they can be put in your own plant. Send us a brief description of your requirements as we undoubtedly have a record of a similar installation and can give you definite information.

Write for Bulletin.

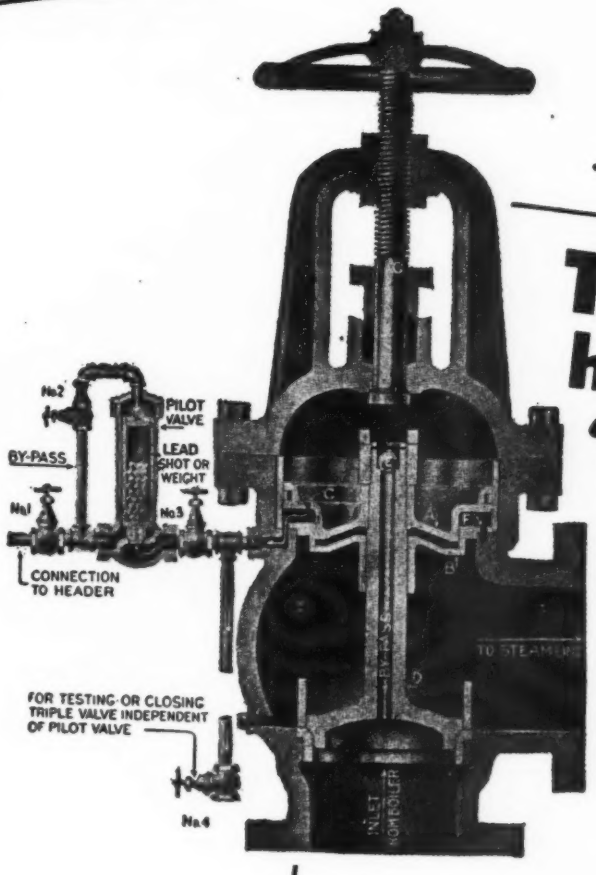
FLEXO SUPPLY COMPANY, Inc.

4224 Olive Str. St. Louis, (8) Mo.

In Canada

S. A. Armstrong Ltd., 115 Dupont St. Toronto(5)

Ever think what a line rupture might do to your plant?



This Valve will help you out of "Tight Spots"

We don't say that steam lines *will* rupture in your plant—but should that happen it would mean a serious loss in time and production. You can insure yourself against that possibility by installing the GOLDEN-ANDERSON Triple Acting Non Return Valve illustrated here. It's designed to prevent burst steam lines by automatically cutting in the boiler at the instant boiler pressure equals lineheader pressure . . . and to isolate or cut off the flow of steam whenever boiler pressure falls below line header pressure. Further, this valve stops the flow of steam from the boiler in case line header pressure drops suddenly.

Complete information . . . operating and construction diagrams plus full descriptions . . . on this and all GOLDEN-ANDERSON Specialty Valves is contained in our catalog. Write for your copy.

GOLDEN-ANDERSON
Valve Specialty Co.
1300 FULTON BLDG.
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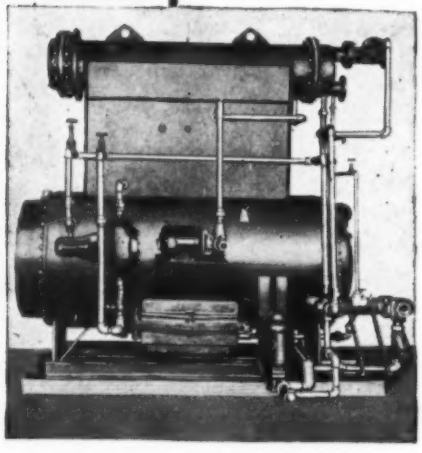
SELF-DESCALING

EVAPORATORS

BY HEAT TRANSFER PRODUCTS Inc.

Engineers *Manufacturers*



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HTP

PLANT: CARBONDALE, PA.
90,000 Square Feet

A new-type bi-metal tube shrugs off scale! Developed by Heat Transfer Products, Inc. (U.S. Patent) the self-cleaning tubes offer new advantages to power plants for producing feed water. When the tube is heated the difference in expansion of a Monel strip and the Admiralty tube causes it to curve. Cooling straightens it. Flexing shrugs off scale which can be flushed out or pulled out through cleanout door.

STEAM CONDENSERS

COOLERS
Fresh Water Lubricating Oil

EVAPORATORS
Self Descaling (Patented) Coil Type

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DISTILLERS

STEAM JET AIR EJECTORS

FEED WATER HEATERS

VENT CONDENSERS

IF IT'S TRANSFER OF HEAT—CALL HEAT TRANSFER

New Gas-Diesel Design Cuts Fuel Consumption

Discovery in the diesel engine field enables engine operator to use either gas or oil as fuel without any electrical sparking device, according to R L Boyer, chief engr, Cooper-Bessemer Corp. This is said to cut fuel consumption of gas engines 20 to 25%. New discovery is result of experimentation which began in 1928. Recently efforts have been rewarded by successful operation of a natural gas engine on the diesel principle. This enables unit to operate on a wide variety of fuels, including fuel oil, natural gas, manufactured and coke oven gases, sewage gas and refinery byproducts.

Conversion from liquid to gas fuel is as simple as closing one valve and opening another with engine operating continuously at full load. New principle enables engine to have same fuel economy regardless of fuel utilized. It raises normal 25% thermal efficiency of gas engine to 35% thermal efficiency common in diesel engines. Development makes possible the use of gas at normal pressure and change from one fuel to another without necessity of a shutdown. Cooper-Bessemer has engines embodying the new principle in production.

Dan Gutleben of "Log" Fame Retires

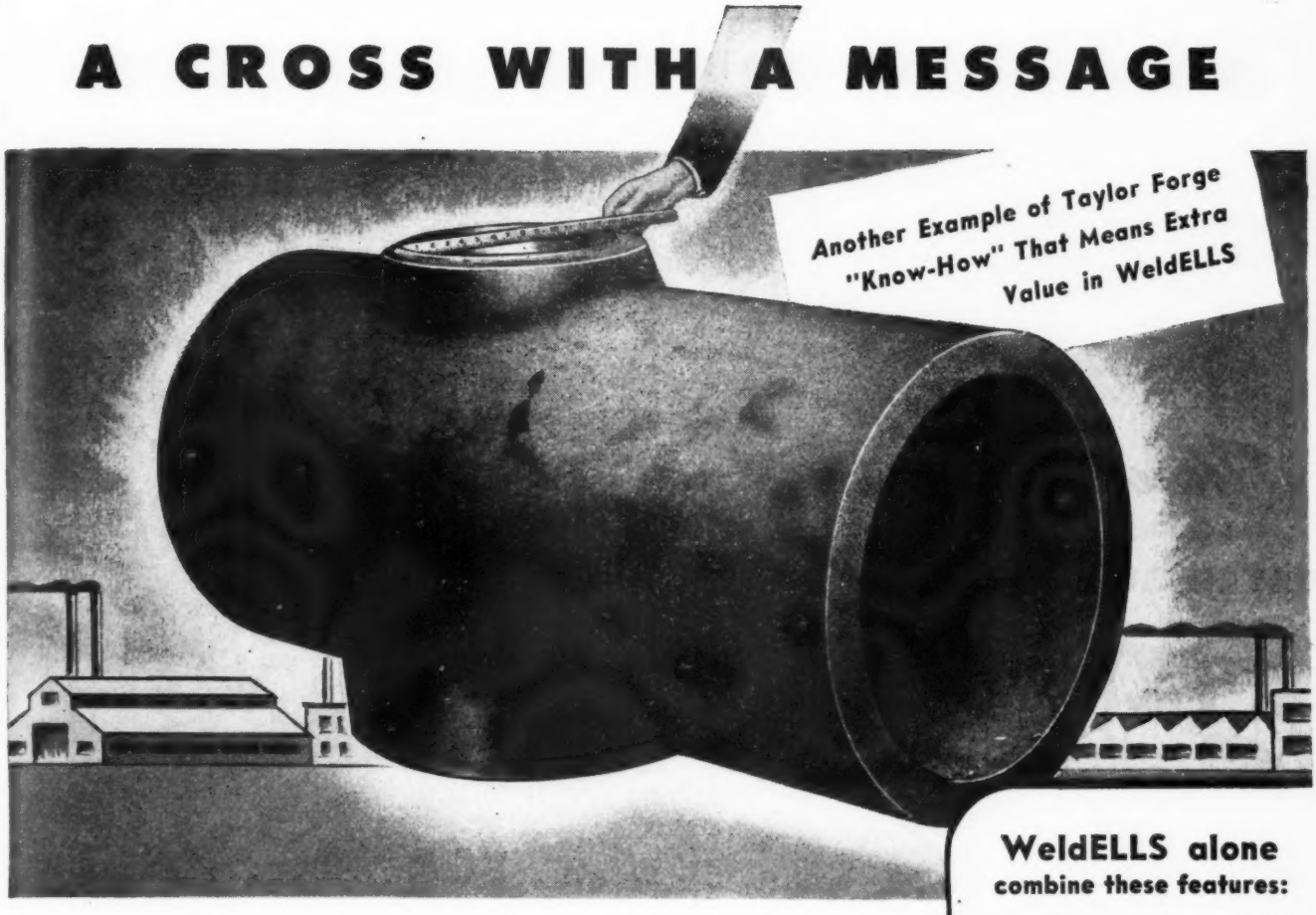
After close to quarter of a century with Pennsylvania Sugar Refining Co, Dan Gutleben, plant engineer, recently retired or, as he puts it, is now relieved of the restrictions of a gainful occupation.

In a parting letter to the "sugar tramps," Dan said, "Last spring I sensed a slackening of agility and enthusiasm and so decided it was time to give notice. I have on several occasions had the distressing experience of succeeding an old man who hung on till his nerves and head had become incapacitated. Twenty-four years of 7-day weeks on a line job with the relentless urge for the daily maximum of production can develop dangerous reactions. With old age stealing up, the confidence in the good right arm diminishes . . . A man ought to step down before his vitality is gone and his arteries become ossified."

POWER readers will remember Dan's famous "log," a running, illustrated record of the happenings, big and small, technical and human, that made up the day-by-day life of the refinery. Many excerpts from the log appeared in POWER and it is the hope of the editors that Dan will now find time to review the log, grown to 40 volumes of text, pictures and drawings, and select from it more choice bits for the edification of power engineers.

National Association of Power Engineers, Illinois No. 28, presents on March 22, 8:00 PM, at the Midland Club, 172 W Adams St., Chicago, a lecture and demonstration of electronics. How electron tubes work and where they are applied will be explained by Don P Cleverly, author of *A Primer of Electronics* and commercial engineer for Sylvania Electric Products, Inc.

A CROSS WITH A MESSAGE



★ *When the big crosses originally furnished on an important oil refinery job began to show signs of failure the contractors (one of the biggest and best firms of refinery engineers and contractors in America, by the way) decided to replace them with wrought and forged fabricated units.*

Like so many other difficult and exacting jobs this one was turned over to Taylor Forge, and the cross pictured above is one of a number made of seamless carbon moly tubing furnished by the contractor. The outlets are integrally formed to close tolerances. The run ends will be beveled like the outlets and Taylor Forge Flanges welded to both ends of the run and to the outlets. Perhaps in a later issue of this magazine we can show you the complete unit.

HANDLING jobs like this is a matter of knowing exactly how hot metal behaves and how to control its movements under pressure and impact. That knowledge, acquired through 40 odd years of experience and continuous research, is Taylor Forge's biggest single asset. It enables us to make WeldELLS and other Taylor Forge Welding Fittings exactly what they should be—to place the right amount of reinforcement just where it is needed, to provide tangents which keep the weld away from the most highly stressed zone. In short, to make WeldELLS the fittings that *"have everything"*.

WeldELLS alone combine these features:

- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

WeldELLS have everything

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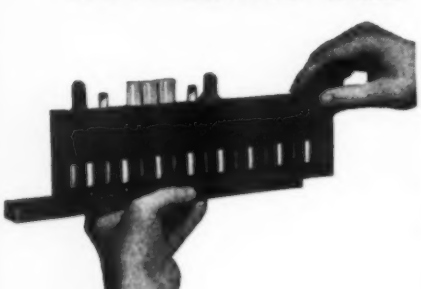
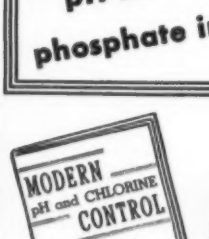
Keep Tab with a Miniature Lab



You CAN MAKE ACCURATE, SPEEDY DETERMINATIONS OF pH and PHOSPHATE IN 3 EASY STEPS WITH TAYLOR COMPARATORS

pH in 60 seconds

phosphate in 2 minutes



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FREE BOOKLET Describes modern scientific outfits, (priced as low as $19.00) and improved methods employed by industry to step up boiler efficiency and prevent damage to equipment caused by scale, corrosion and embrittlement. Accuracy is Assured for ALL Taylor Liquid Color Standards Carry An UNLIMITED GUARANTEE AGAINST FADING.

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Vets Get Job Education Through Training Program

Ohio's first industrial rehabilitation program for returned war veterans at Mt. Vernon plant of Cooper Bessemer Corp last June is now settling postwar job future for 17 former members of armed forces.

Program is being conducted with cooperation of Rehabilitation Division of Veterans Administration. Courses, which take four years to complete, call for 8232 hours of shop work and 768 hours of related classroom instruction. As they complete the course, veterans receive from Ohio a completion certificate as evidence that they qualify as full-fledged machinists. Company presents each man with a $100 bonus and offers him a job as journeyman machinist. During the course participants receive standard apprentice pay from Cooper Bessemer in addition to their government allowances. Total is equivalent to a journeyman machinist's pay, thus enabling trainee veteran to take his place in community life at beginning of training period.

Program provides for a veteran who may have gone to the armed services from high school without previous job training, a physically disabled veteran unable to pursue his former occupation, and a veteran whose work may not have given him special postwar qualifications. An apprenticeship committee of three representatives of labor and three of management supervises the program. Mt. Vernon superintendent of schools is an ex officio member of the committee.

Meeting Cancellations

In cooperation with recent government request that no conferences be held where over fifty people are present, unless essential to furthering the war effort, Annual Commercial Conference of Edison Electric Institute for March 26-29 at Edgewater Beach Hotel, Chicago, has been cancelled.

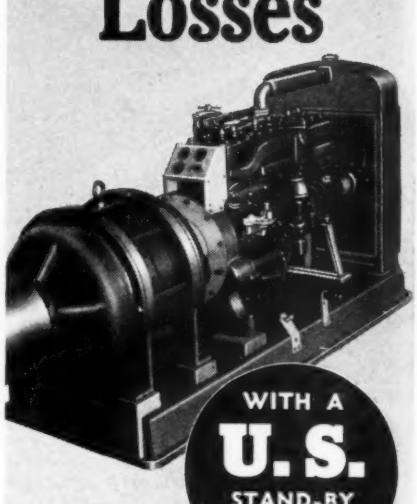
American Society of Tool Engineers has indefinitely postponed Industrial Production Planning Exposition, scheduled for Cleveland in March, to help relieve domestic transportation crisis.

Industrial and Commercial Lighting Equipment Section of National Electrical Manufacturers Association postpones until next year International Lighting Exposition scheduled for Chicago on April 19-23.

American Society for Testing Materials cancelled ASTM Committee Week, which had been planned for Pittsburgh, Pa., during week of Feb 26, and deferred their spring meeting scheduled for Feb 28.

Midwest Power Conference, scheduled for April 9 and 10 at the Palmer House, Chicago, has been cancelled. This would have been the eighth annual meeting of the conference, which is sponsored by Illinois Institute of Technology with other educational institutions and technical societies cooperating. There will be no publication of the papers planned for this year's conference. Meeting will be resumed as an April feature as soon as wartime regulations permit.

Insure Against POWER FAILURE Losses



WITH A **U. S.** STAND-BY ELECTRIC PLANT

It is wise to safeguard electric ovens, furnaces, electrolytic processes and other crucial operations with stand-by service to avoid losses of power failure. We specialize in the building of this type of Emergency Electric Plant equipment and have successful installations in varied applications throughout the nation. Write for specific details.

UNITED STATES MOTORS CORP.
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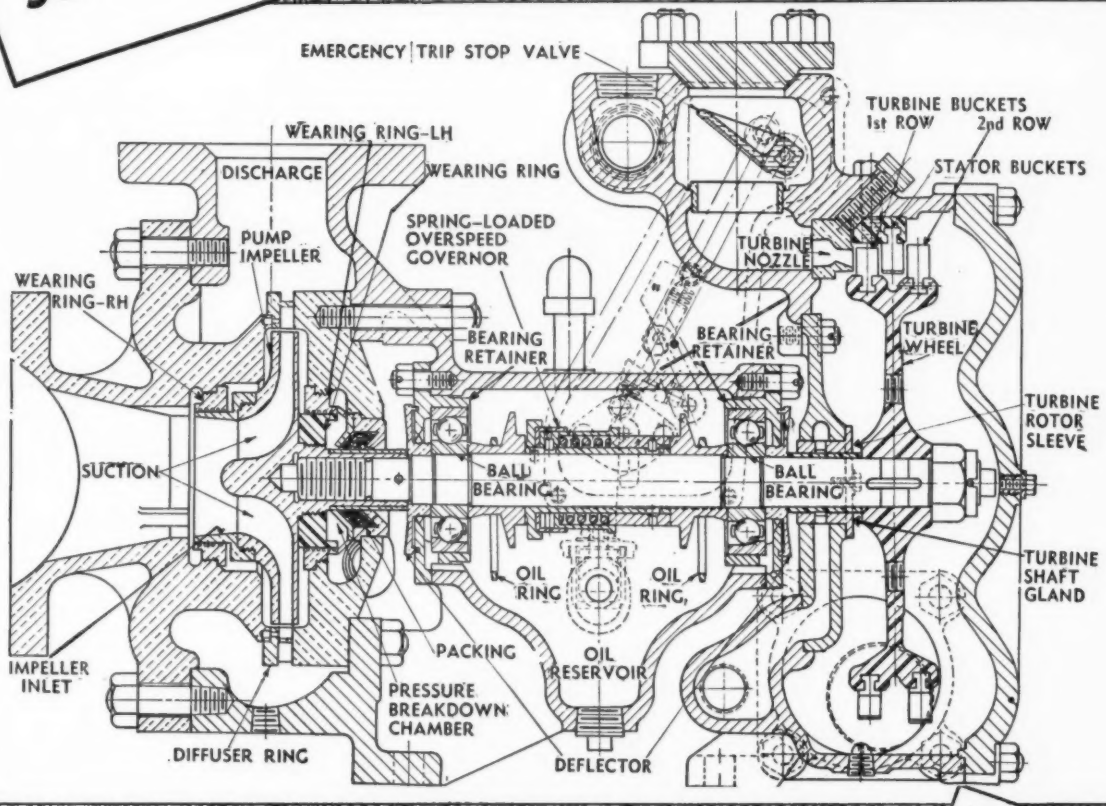
The U. S. line includes Gasoline and Diesel Units up to 75 KW.

U.S. ELECTRIC PLANTS FOR STAND-BY SERVICE

COFFIN TURBO PUMPS

The Pump and Turbine ends are selected and coordinated to economically meet your Boiler Feed Requirements to

350 GPM., 500 PSI.



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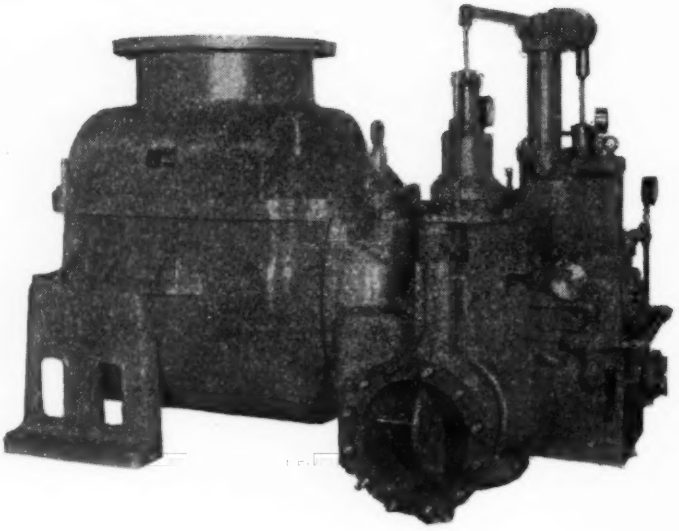
MULTISTAGE
STEAM TURBINES



Another MURRAY multistage steam turbine, designed to deliver 350 horsepower on low pressure steam at 5 pounds and exhausting to 26 inches Hg vacuum. It is provided with single inlet valve with 10 inch flange, and 24 inch exhaust facing up. This unit will pay for itself in a short time, since it utilizes what would otherwise be wasted energy, since an excess of low pressure steam existed.

Equipment includes variable speed oil relay governor, butterfly type emergency trip valve, strainer surrounding the double seated balanced governor valve.

The complete MURRAY line of turbines includes all variations of mechanical drives, and turbine generator sets up to and including 2500 KW rating.

Sales Representatives for Murray products are located in all principal cities.

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA
Builders of Steam Power Equipment for Three Quarters of a Century

APPOINTMENTS

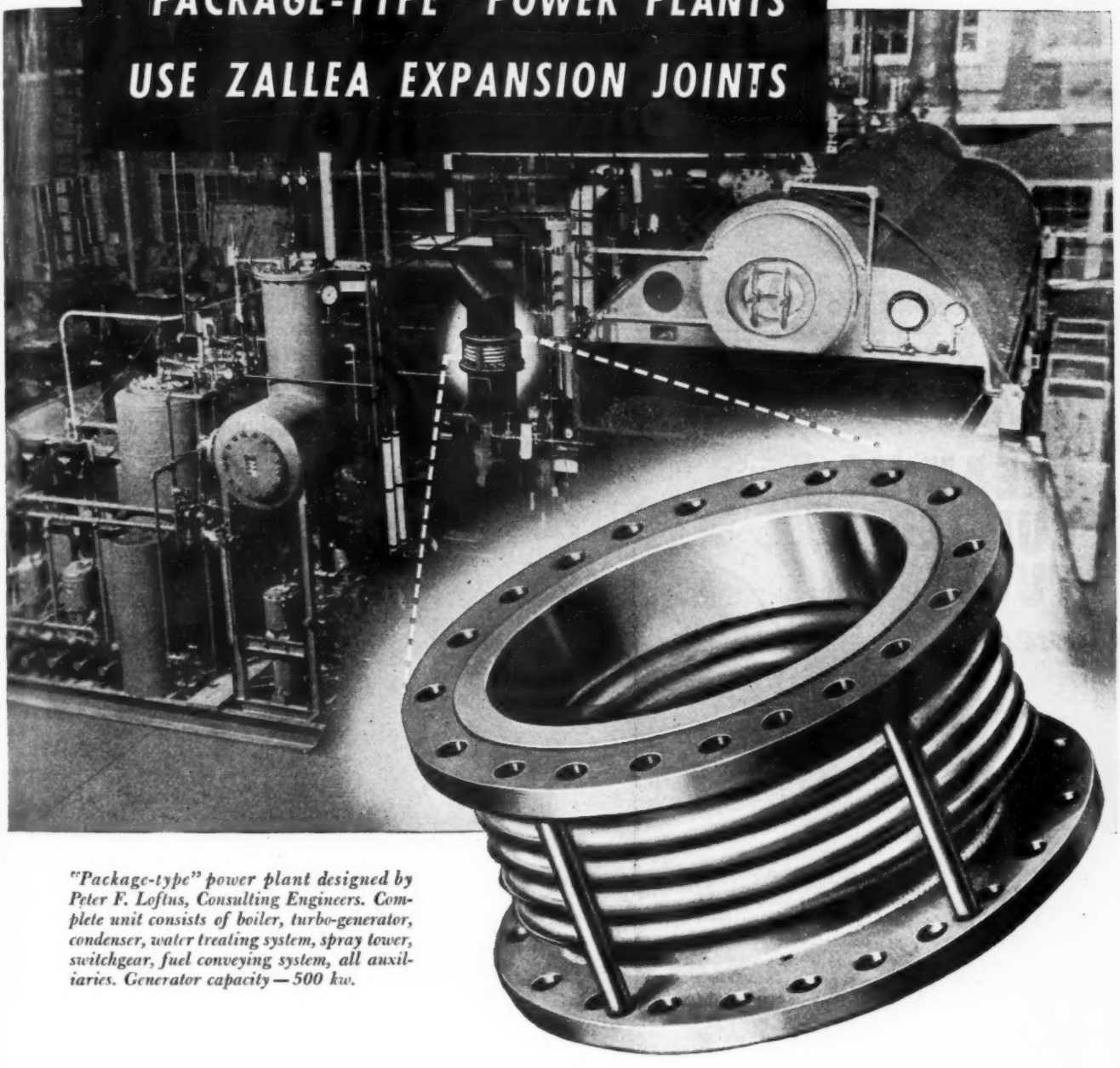
Allis-Chalmers Mfg Co announces appointment of **Archibald J Cooper** as manager of the New York district office. **A F Rolf** now will devote full time to his duties as assistant secretary. **Jay C Warner** will assist in development of sales in Far East, Australia and New Zealand. . . . **Morse Chain Co** elects **Walter W. Bertram** as vice-president in charge of sales and **Robert J Howison** as sales manager . . . **Dr Robert V Yohe** has been elected vice-president of **American Anode, Inc,** a B F Goodrich affiliate . . . **Thermoid Co** plans to purchase **Grizzly Mfg Co's** plant and equipment at Los Angeles, Calif.

Plant Rubber & Asbestos Works appoints **J C Voiles** as chief engineer with headquarters at San Francisco main office; **R E Bounds** becomes manager of industrial construction dept for Los Angeles district . . . **Worthington Pump & Machinery Corp** elected **Clarence E Searle** president, **Harry C Beaver** vice-chairman of board of directors and chairman of management committee, **Hobart C Ramsey** executive vice-president, **Edwin J Schwanhausser** vice-president in charge of sales and **Leslie C Ricketts** vice-president . . . **Link-Belt Co** have moved their Huntington, W. Va., office to W. Va. Bldg at Fourth Ave and Ninth St.

Wickwire Spencer Steel Co has made **William J Murray** assistant sales manager of fence div and **A S Rairden** sales manager of wire rope div. **Robert T Dunlap** has been elected a member of board of directors . . . **Timken Roller Bearing Co** appoints **John J Yezbak** manager of public relations as well as head of the news bureau. **Everett C Hite** has been made combustion and refractories engineer in steel mill metallurgical dept . . . **Lunkenheimer Co** has appointed **Frank P Rhame** general manager, succeeding Charles A Brown. **Homer E Lunken** becomes assistant general manager. **Carra L Lane** has been named works manager, succeeding George A Seyler. **Fred H Hehemann** becomes chief engineer, succeeding **Jerome J Aull.**

Stone & Webster Engrg Corp elected **J R Lotz** chairman of board, **Russell T Branch** president, **Emmart LaCrosse** vice-chairman, **Joseph Pope** first vice-president and Karl Finsterbusch, H E Brailey, R E Argersinger and H L Bunce, Jr, vice-presidents. Also, following changes affecting executive and administrative personnel of engineering dept were announced: **E LaCrosse,** vice-chairman and director of engineering, will continue to have general charge of these activities, but will be relieved of certain detailed management duties, which will leave more time for outside contacts in industrial and public utility fields. **A C Klein** becomes engineering manager; **James A Powell,** chief mechanical engineer; **W F Ryan** and **F E Hertel,** assistant engineering managers. **M W Carty** is now senior mechanical engineer, **G R Strandberg** chief hydraulic engineer and **R E Argersinger** consulting engineer. **H L Bunce, Jr,** becomes man-

"PACKAGE-TYPE" POWER PLANTS USE ZALLEA EXPANSION JOINTS



"Package-type" power plant designed by Peter F. Loftus, Consulting Engineers. Complete unit consists of boiler, turbo-generator, condenser, water treating system, spray tower, switchgear, fuel conveying system, all auxiliaries. Generator capacity—500 kw.

THE "package-type" portable power plant was born of the needs of war—and of postwar rehabilitation. They are so designed that they can be "packaged" and sent overland and overseas. They can be readily moved from one location to another to meet critical demands for power in military and industrial operations.

In service such as this, each and every functional unit and auxiliary must be selected on the basis of ability to operate continuously with little maintenance or attention. It is, we believe, significant that Zallea stainless steel expansion joints were chosen to absorb lateral motion in the 20" vapor line between the turbine exhaust and condenser.

Zallea Standard Expansion Joints can be supplied in sizes from 4" to 30" diameter, of many types of stainless steel as well as copper. We fabricate special expansion joints to meet practically any condition of pressure, temperature and corrosion, and stand ready to consult with you on either standard or special requirements.

"Code-Craft"...

ZALLEA BROTHERS & JOHNSON

...EQUIPMENT FOR THE PROCESS INDUSTRIES

814 LOCUST ST. • WILMINGTON 99 • DEL.

Put "AMBEST" to a long life test on any tough job

This UNIVERSAL packing — of long, pliable, anti-friction metallic alloy strands — assures low cost, long life packing protection and easy application on any rod in good condition. "AMBEST"—available for all pressures and temperatures up to 550° F.— is recommended for pumps, compressors, engines, throttles and valve stems. All needs are supplied by one packing when you use "AMBEST."

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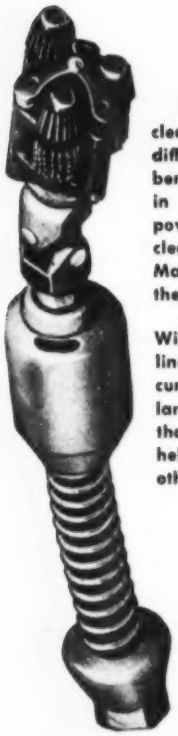
Write for Working Sample
Send for 36 page catalog

EUREKA PACKING CO., 294-296 St., BROOKLYN 20, N. Y.

What does

CLEANING CURVED TUBES

mean to you?



Does it mean jamming of the cleaner when approaching curves—difficulty in negotiating short-radius bends—slowing up of tube cleaning in bends because of insufficient power—difficulty in withdrawing the cleaner after traversing a curve? Many engineers encounter all of these problems.

Wilson, however, has developed a line of tube cleaners for use in curved tubes from 1" O.D. to the largest ever cleaned—tube cleaners that will go a long way toward helping you overcome these and other curved-tube-cleaning troubles.

Thomas C. Wilson's engineering staff is available for consultation on difficult or unusual tube cleaning problems. A 40 page bulletin describing the complete Wilson line—and a copy of the Wilson Tube Cleaners Check List will be sent on request.

Modern tube-cleaners for the problems of today.

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PIPE AND TUBE CLEANERS EXCLUSIVELY

THOMAS C. WILSON Inc.
21-11 44th AVENUE, LONG ISLAND CITY 1, NEW YORK

ager of business studies and reports and **M H Cutler** assistant chief structural engineer. Because activities of petroleum div cover a broader scope than its designation connotes, its name was changed to process div and personnel titles changed as follows: **Harry S Houghton** to chief process engineer; R J Carter, T E Casselman, C T Chave, A W Pratt, H C Schutt and R L Geddes to process engineers.

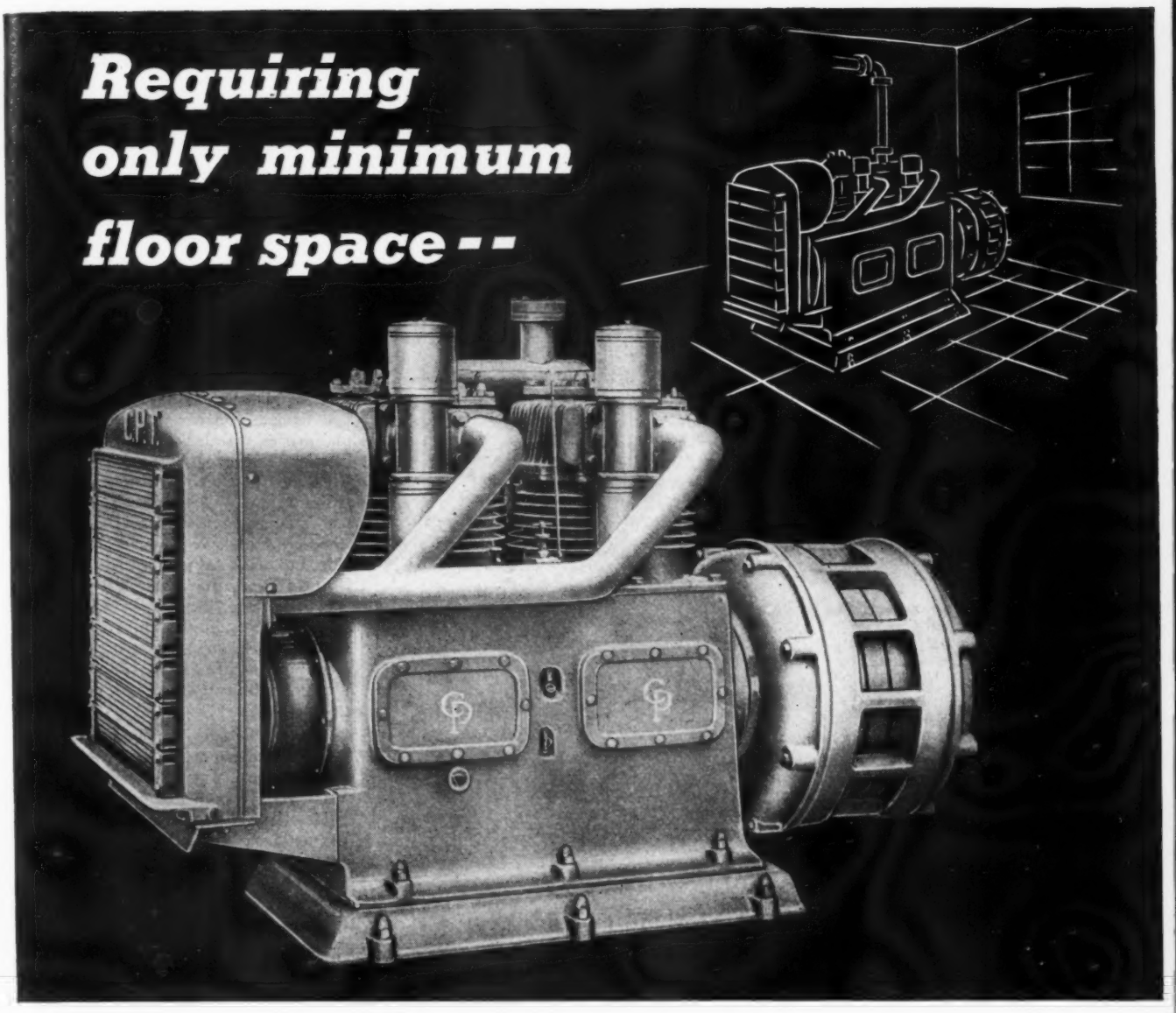
Cleaver-Brooks Co appoints **Frederick W Hainer** vice-president . . . **Buffalo Forge Co** has appointed **N R Johnson** factory manager and **H D Hebard** director of purchases . . . **Lou Boudreau** joined **Whiting Corp's** personnel dept . . . **Swartwout Co** has named **Earl L Wiseman** vice-president and **Royal L Meyer** chief engineer and assistant manager of steam div . . . **Alexander J Tigges** has been appointed district technical advisor of **Air Preheater Corp,** with offices in New York.

Edwards R Fish, 30 Laurel Ave, Windsor, Conn., announces that his services are available as engineering consultant on design, construction, installation, operation and maintenance of boilers and unfired pressure vessels . . . **Marvin Wright** has been appointed purchasing agent of Iowa Elec Light & Power, Iowa Elec, Central States Elec, Northwestern Light & Power, Cedar Rapids & Iowa City Railway, Tama & Toledo Railroad. He will also continue as general traffic manager of Cedar Rapids & Iowa City Railway.

John L Sybrandt retires and **Lowell E Sennet** succeeds him as manager of **Ludlow Valve Mfg Co's** Chicago office . . . **Chase Brass & Copper Co** has appointed **Marvin A Joy** assistant general sales manager of mill div at Waterbury. **Walter E Evans** will take over duties of sales manager of midwestern div at Cleveland. **John S Coe** has been appointed assistant to vice-president in charge of Cleveland operations. **R E Fritsch** has been elected president of **Tube Turns,** succeeding Walter H Girdler, Sr . . . **Hercules Elec & Mfg Corp** are now located at 2500 Atlantic Ave, Brooklyn 7, N. Y. **Johns-Manville Corp** elects **Kenneth W Huffine** vice-president in charge of new engineering dept at New York headquarters.

Westinghouse Electric & Mfg Co appoints **Thomas I Lane** as assistant to central district manager, **E W Hoffman** as central district order supervisor and acting stock supervisor, and **A B McKelvy** as staff assistant. **Miss Beryle Priest** has joined illuminating engineering dept of lamp div. **Earl W McBratney** was named sales promotion manager and **Arthur F Sheean** lamp manager for North Pacific district. **George S Ryan** has been appointed assistant to vice-president, **C B Dick** manager of feeder div and **E R Perry** manager of Micarta div. **S C Hoey** has been made assistant director of headquarters manufacturing engineering dept.

Westinghouse Electric & Mfg Co announces establishment of a New England district of lamp division's field organization and appointment of **George H MacGilvray** as district manager. **W O Lipp-**



CP Two-Stage Air-Cooled Compressors

EXTREMELY compact, Class PM Two-Stage Air-Cooled Compressors are ideal for installation where floor space is limited. Durable Simplate Valves, effective intercooling, inlet valve unloading system and force feed lubrication afford high efficiency and minimum maintenance.

Class PM Compressors are available in direct-connected type with built-in or coupled motor, or V-belt drive, in sizes ranging from 78 to 445 c.f.m. piston displacement, for pressures up to 125 pounds. Write for a copy of Bulletin 759, 5th Edition.

There is a CP Air Compressor, stationary or portable, for every air requirement from 25 to 10,000 c.f.m. actual capacities and for pressures up to 5,000 pounds.

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PNEUMATIC TOOLS
ELECTRIC TOOLS
HYDRAULIC TOOLS
ROCK DRILLS

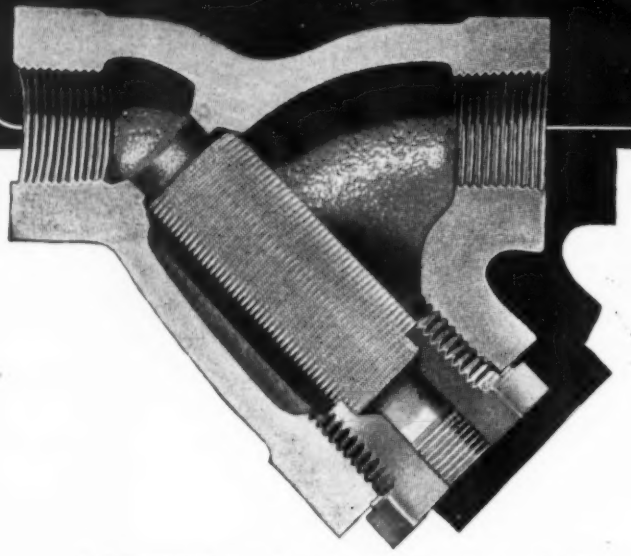
CHICAGO PNEUMATIC
TOOL COMPANY
General Offices: 8 East 44th Street, New York 17, N. Y.

★★★★★★★★
AIR COMPRESSORS
VACUUM PUMPS
DIESEL ENGINES
AVIATION ACCESSORIES

It says

"STOP" to Solids—

"GO" to Fluids



A BETTER Strainer to "police your pipelines"

- **FIRST**—*The Screen*, a high-grade woven Monel wire basket that catches solids—lets condensate, oil or other fluids flow freely.
- **SECOND**—*Finish*. Cadmium plated inside and out for protection against corrosion.
- **THIRD**—*Easily Cleaned*. Blow-off bushing made for easy removal. Bushing and Screen come out together. Screen automatically aligns on reassembly.
- THOUSANDS IN SERVICE—Sold by over 100 Mill Supply Houses.

6 sizes from ½" to 2" for pressures up to 600 lb. Reasonably priced. See your supply house or write for Bulletin S-200.

YARNALL-WARING COMPANY
100 Mermaid Ave. PHILADELPHIA 18, PA.

YARWAY STRAINERS

man was named assistant to president in charge of headquarters manufacturing dept; he will also continue as manager of U. S. Naval Ordnance Plant at Canton, Ohio. **J R Weaver** was named works manager of East Springfield, Mass., works of electric appliance div. He will also continue as manager of U. S. Naval Ordnance plant operated by company at Center Line, Mich. **Ellis L Spray** was elected vice-president and general manager of **Westinghouse Electric Elevator Co** in Jersey City, N. J.

Robert P Smith has been appointed general farm sales manager of **Westinghouse Electric Supply Co,** with offices in New York. **Houston B Watson** has been made apparatus and supply manager of Southwestern district. **Charles R Matthews** was named manager of Northern California district, with headquarters in San Francisco. Westinghouse Supply buys **Pixley Electric Co,** which will be the headquarters for new WESCO West Central District. Manager of district, which also embraces outlets in Cincinnati and Evansville, Ind., is **L A Pixley.** Appointment of **Clinton R Hanna** as associate director of **Westinghouse Research Laboratories** has been announced. He is also manager of electro-mechanical dept of laboratories. **Westinghouse Radio Stations, Inc,** elects **Walter E Benoit** as vice-president.

General Electric Co names **Lawrence Jennings** assistant to E O Shreve, vice-president in charge of customer relations. **C H Lang** has been given direction of application and service engineering in apparatus dept. **A K Bushman** has been appointed manager. **G W N Riddle** has been given responsibility for media in advertising of apparatus dept products. **Ralph J Cordiner** has been elected vice-president of GE. He also remains as assistant to **Charles E Wilson,** president.

Fisher Governor Co announces appointment of **Allan K Cook** as exclusive sales and engineering representative in Western Kentucky and Southern Indiana, with headquarters at 505 S Third St, Louisville, Ky. . . . **Honan-Crane Corp** has named **B F Hunter** consulting engineer in charge of research and sales engineering. He also serves as chief of research.

Air Reduction Sales Co announces following appointments: **H F Henriques** becomes general sales manager; **J J Lincoln,** director of sales services; **C M Bloodgood,** assistant to vice-president in charge of sales. All of the above will have offices at 60 E 42nd St, New York City. **H P Etter** has been appointed sales manager of Pacific Coast div, with headquarters in Mills Tower Bldg, San Francisco . . . Peoria office of **Lincoln Electric Co** has been moved to 214 Second St . . . **C F Patterson** joins **Eutectic Welding Alloys Co's** field engrg staff for Mich. **John A Owen** joins company as field engineer for N. Carolina.

Northern Equipment Co appoints **W L Hunter** chief engineer, **H A Schlieder** assistant chief engineer and **H H Weining** director of research . . . **C J Tagliabue Mfg Co** sold its assets, including good

NICKEL AIDS THE POWER INDUSTRY

to KEEP 'EM OPERATING!

In this day of acute shortages of almost everything, power plant engineers are doing an amazing job of meeting demands for power—the power to keep 'em operating.

Part of this success is due to their foresight in specifying materials that assure long life and withstand the added hardships imposed by ever-increasing peak-load demands.

With the production of tanks, guns, and planes dependent upon power capacity, Nickel makes a valuable contribution towards uninterrupted operation, through the improved properties it imparts to ferrous and non-ferrous alloys used in power plant equipment.

So today the exigencies of war illustrate more clearly than ever the simple truth of the familiar axiom, "A little Nickel goes a long way" toward increasing the dependability of power plant equipment, from turbine blades to high pressure valves, from flange bolts to shaft forgings.

The technical staff of International Nickel has been privileged to cooperate with the power plant engineers and Government authorities who have made possible the great increases in power on which so much of the war effort depends. INCO engineers and metallurgists offer counsel and data to all who desire assistance in the selection, fabrication, and heat treatment of ferrous and non-ferrous metals.

New Catalog Index

New Catalog C makes it easy for you to get Nickel literature. It gives you capsule synopses of booklets and bulletins on a wide variety of subjects—from industrial applications to metallurgical data and working instructions. Why not send for your copy of Catalog C today?

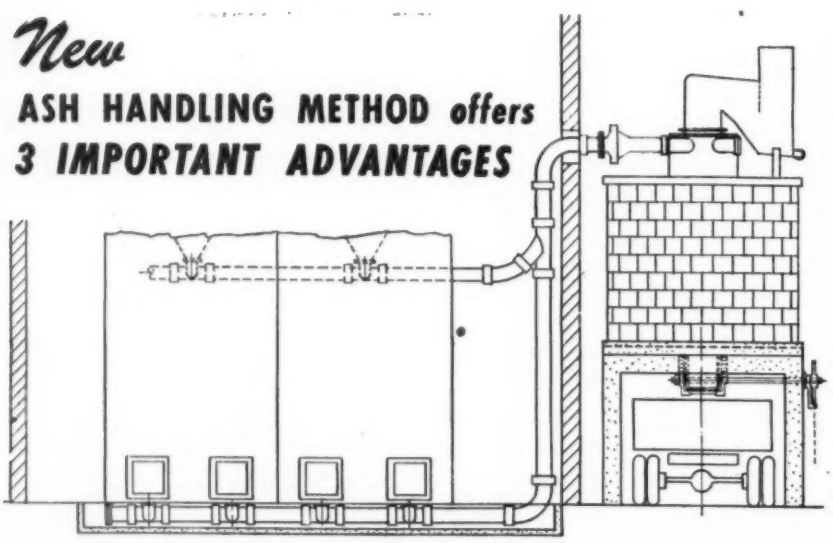
* Nickel *

THE INTERNATIONAL NICKEL COMPANY, INC., *67 Wall St., New York 5, N. Y.*

New

ASH HANDLING METHOD *offers*

3 IMPORTANT ADVANTAGES



In the Beaumont "Vac-Veyor" pneumatic ash handling system the exhauster, receiver, separator and air washer are combined as one unit. Operating advantages include: (1) All ash delivered into the silo, none into the air. (2) Ashes delivered practically dry, which minimizes the possibility of packing or freezing in the silo. (3) Continuous operation, with low steam consumption. What are your ash handling problems? Send today for literature.

BEAUMONT BIRCH COMPANY

1505 RACE STREET PHILADELPHIA, PA.

DESIGNERS • MANUFACTURERS • ERECTORS OF COAL AND ASH HANDLING SYSTEMS

This Welded Joint

Eliminates Protrusions in pipes!

The Westport Patented Welded Joint provides a smooth pipe contour at the base of every weld.

There are no "icicles" . . . no protrusions!

This new method, especially suitable in the welding of heavy wall piping for high-pressure-temperature conditions, is proving satisfactory in lines operating at 1250 pounds per square inch and 925 degrees F. total temperature steam service.

Mitchell's service includes this Westport method, which consists of the use of a joint in which the ends to be welded are formed and machined to provide a special U-shaped groove, joining the lips at the root of the weld by the oxyacetylene process and completing the joint by the usual electric arc procedure.

Important: With the Westport Joint, there's no sacrifice in the strength of the pipe due to removal of wall or Backing Ring . . . there are NO gaps between rings and inside of the pipe wall . . . and there's greater flexibility in alignment of pipe, valves and fittings!

WRITE WITHOUT DELAY FOR FULL DETAILS

W. K. MITCHELL & CO., Inc.

PHILADELPHIA 46, PENNA.

1899 M 1945

will, name and patents, to **Portable Products Corp,** Pittsburgh, Pa. . . . **General Controls Co** announces appointment of **Joseph W Wilson** as manager of Glendale, Calif., branch office . . . **Cornell-Dubilier Electric Corp** names **K C Burcaw** sales manager of jobber division . . . **Electric Storage Battery Co** elects **Lester E Lighton** vice-president in charge of engineering . . . **W S O'Connor** has been appointed district sales manager of **U. S. Gauge Co** at 233 Broadway, New York.

CURRENT AWARDS

Phelps Dodge Copper Products Corp, Inca manufacturing div, has received four stars for its "E" flag. **Chain Belt Co** and **Skilsaw, Inc,** added third stars.

Briggs Clarifier Co has been awarded a second star. **Cochrane Corp** and **Infilco, Inc,** have received the same honor. **Burke Electric Co,** power piping div of **Blaw-Knox Co** and **Farr Co** have received Army-Navy "E" flags.

Cooper-Bessemer Corp has received fifth gold star for its Maritime "M" pennant. **Kennedy Valve Mfg Co** and **Kieley and Mueller, Inc,** have been awarded second stars for their "M" pennants.

Peabody Engrg Corp has been awarded Maritime "M" and Victory Fleet flag. **Farris Engrg Co** won the Maritime "M." Wood River refinery of **Standard Oil Co of Indiana** has received the National Security award.

OBITUARIES

Charles W Appleton, 70, retired vice-president of General Electric Co and former assistant district attorney and magistrate of New York City, died Jan. 10.

Edmund J Hurley, 63, mechanical engineer specializing in heating and ventilating work with Stone & Webster Engrg Corp, died on Jan 4 at Wakefield, Mass.

John W Pauling, 55, vice-president in charge of heating equipment sales, Minneapolis-Honeywell Regulator Co, died Jan 17.

Eshelby F Lunken, 54, president of Lunkenheimer Co, died suddenly Jan 25.

Harvey Morse Cushing, 69, authority on steam power generation and for 22 years chief mechanical engineer of Buffalo Niagara Electric Corp, died recently.

A P Steiner, 71, consulting engineer, formerly chief engineer and superintendent of Landis Tool Co, died Jan 8.

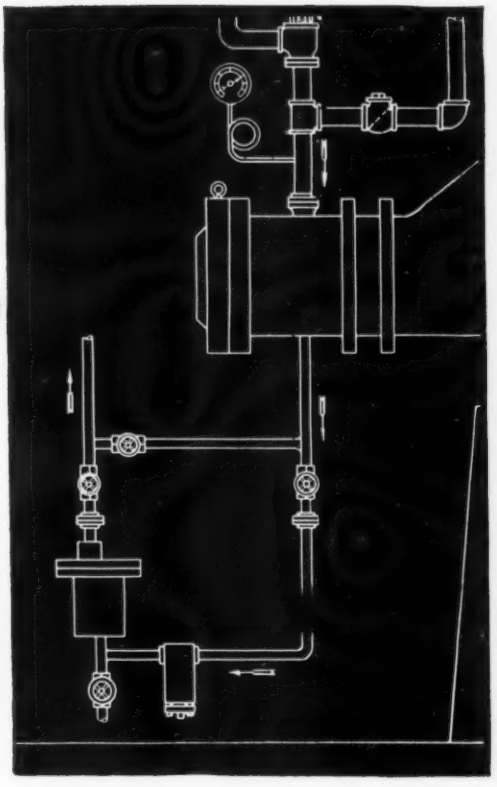
Charles E Griswold, 66, chief engineer of Long Island Hospital in Boston Harbor, died Jan 22.

Harold B Lauer, 51, vice-president of English & Lauer, Inc., died Jan. 3. He was a member of ASHVE and ASRE.

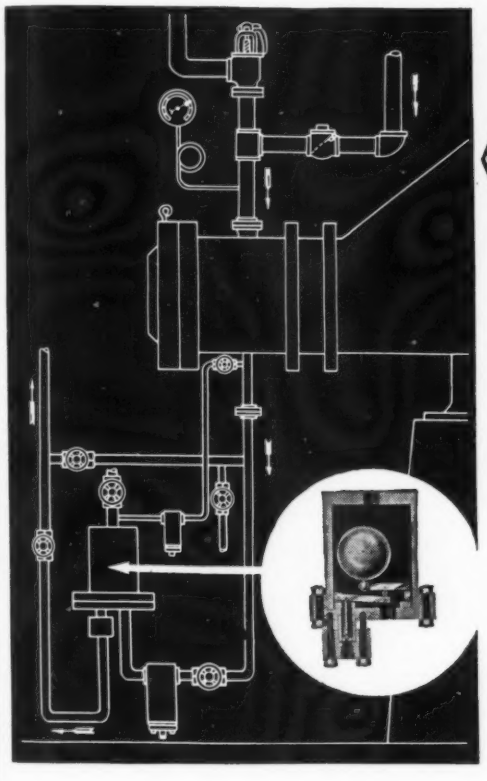
Clyde E Houston, 62, vice-president and general manager of Southern California Edison Co and president of Los Angeles County Fair Association, died on Jan. 8.

Chester B Myers, purchasing agent, died recently after 35 years' service for following companies: Iowa Elec Light & Power, Iowa Elec, Central States Elec, Northwestern Light & Power, Cedar Rapids & Iowa City Railway, Tama & Toledo Railroad.

PROBLEM: MORE ACCURATE TEMPERATURE CONTROL



What would you do?



HERE'S STRONG'S SUGGESTION

Latest refinery practices on reboiler and reflux unit installations include sensitive control instruments on steam supply to maintain the exact temperature required for precise "cuts".

Both Strong open and inverted bucket type traps discharge intermittently, providing a purging action as a part of the operating cycle. This feature, so desirable under most conditions, may result in instrument "lag" in time-temperature processes. On this job condensate must be drained *continuously*.

Working with the STRONG complete line—STRONG engineers have been able to recommend STRONG continuous flow float traps. Compact and dependable, these traps are now in service, permitting more precise "cuts" and insuring successful reactions in this important refinery production phase.

We Furnish the HOW as well as the WHAT WITH!

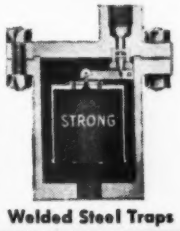
Steam systems will operate with many different types and applications of traps, reducing valves and other specialties.

They operate best only when the *right* units are installed to *best* advantage. That calls for intimate knowledge of your problem, experience with all types of steam specialties—and a complete line to give you the benefit of the unbiased recommendation.

Strong engineers are always ready to help. You can be sure that their recommendations will be backed by long experience with the complete STRONG line, including open and inverted bucket, closed float, float - and - thermostatic (blast) traps, etc.—forged, fabricated (welded) cast and semisteel construction. Send your problems to Strong, Carlisle & Hammond Company, Cleveland 13, Ohio.

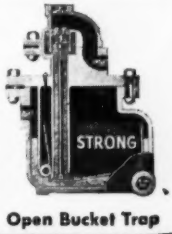
STRONG, CARLISLE & HAMMOND COMPANY
Cleveland 13, Ohio

OTHER STRONG STEAM SPECIALTIES



Welded Steel Traps

Strainer



Open Bucket Trap

Maintenance with POWELL

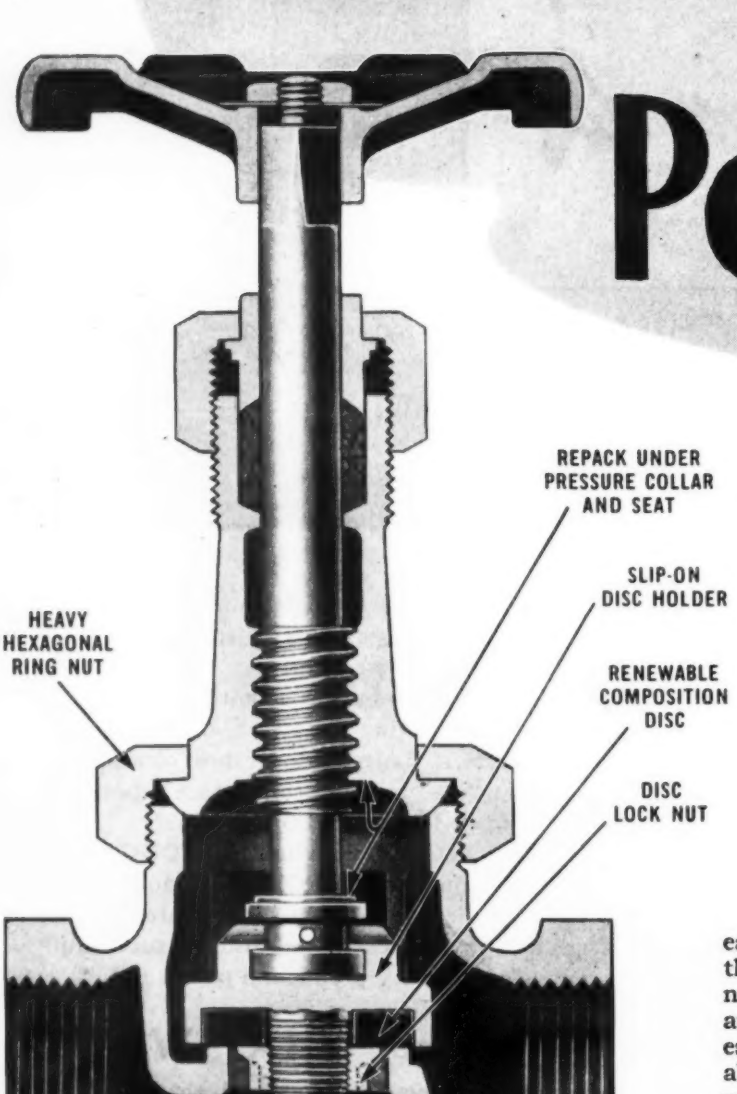


Fig. 150
BRONZE "UNION" COMPOSITION DISC GLOBE VALVE

In these days of round-the-clock operation, time spent in the maintenance of equipment means a loss in production that can never be made up. If it's flow control equipment, Powell has the answers. Here are two examples.

Fig. 150—a Union Disc Globe Valve—is an economical valve for low pressure steam, oil, water, gas or air. The composition disc can be quickly and easily replaced without removing the valve from the line merely by backing off the hexagonal ring nut, lifting the bonnet assembly out of the body and removing the slip-on disc holder. The discs, especially for the smaller sizes, are readily obtainable and very inexpensive. Discs of various compositions are available to meet different service conditions and the importance of using the *right* disc cannot be over-emphasized. The seat can be refaced without removing the valve from the line, as indicated above.

All Powell Valves that require repacking are provided with a specially machined cut-off to permit repacking under pressure when wide open.

POWELL

made easy VALVES

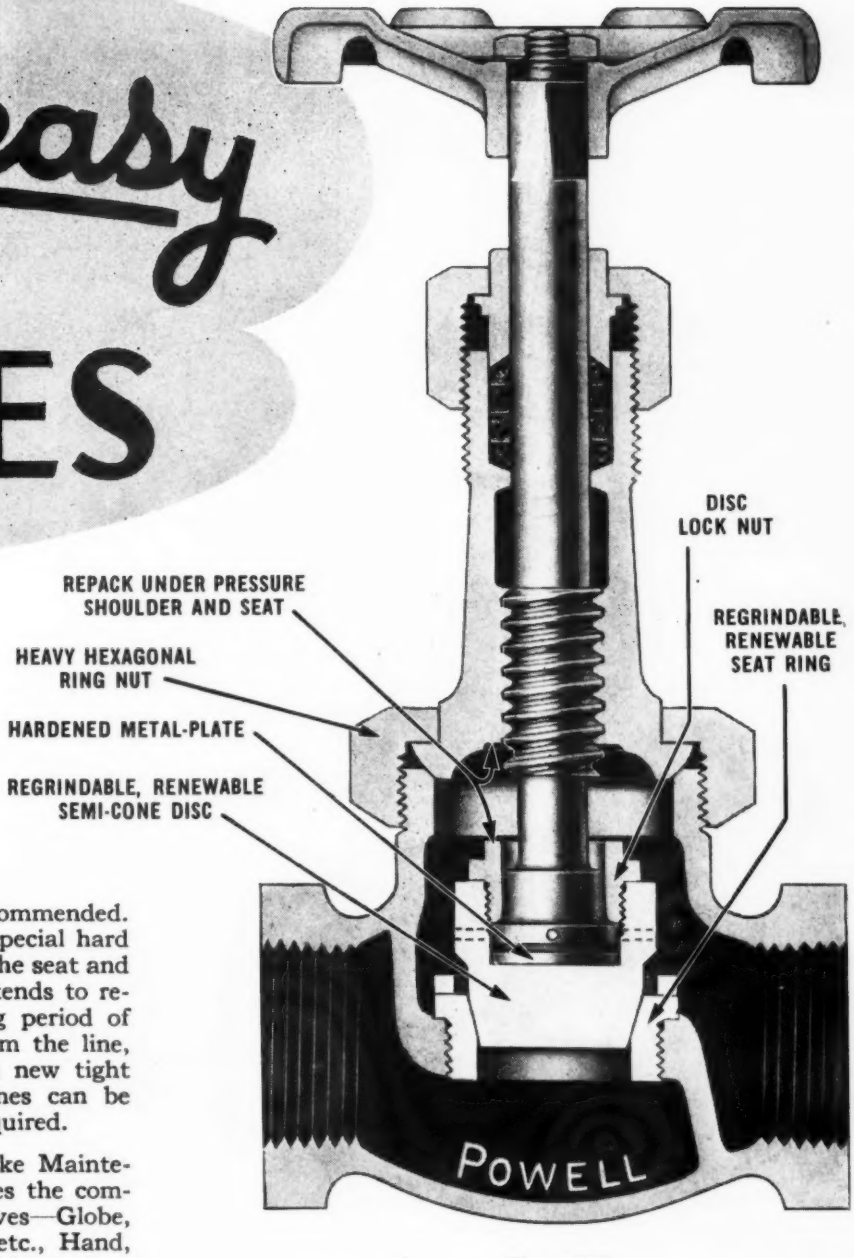


Fig. 1708
BRONZE "WHITE STAR" GLOBE VALVE

For *extra long life,* Fig. 1708 is recommended. The seat ring and disc are made from special hard metal compositions. The hardness of the seat and disc, with their wide contact surface, tends to resist erosion and corrosion over a long period of time. Without removing the valve from the line, seats and discs can be reground to a new tight bearing and, when necessary, new ones can be easily installed. No special tools are required.

All Powell Valves are designed to make Maintenance as easy as possible. This includes the complete Powell Line of Cast Steel Valves—Globe, Angle, Gate, Y, Check, Non-return, etc., Hand, Gear and Motor Operated—for working steam pressures from 150 to as high as 2500 pounds.

The Wm. Powell Company

Dependable Valves Since 1846

Cincinnati 22, Ohio

VALVES

POWER FOR BIG STORES MUST BE SUPER-SAFE

Imagine power failure at dusk in a big store! Lights out...then panic, thievery...bad publicity. It is all too much to risk. That is one reason why large department stores favor ALCO Diesel Engines for safe, sure power, instantly available.

ALCO Diesel Engine designers pioneered in producing Diesel power units that have not only demonstrated extraordinary dependability, but provide required capacity with money-saving reductions in space and weight. On shore, in ships, and in mobile equipment, these characteristics are of vast importance.

These are solid reasons why more than 1,500,000 horsepower of ALCO Diesel Engines are in

service today. ALCO's powerful, reliable, compact, high-speed, ultra-durable engines are an immense advance over massive, cumbersome old-style engines.

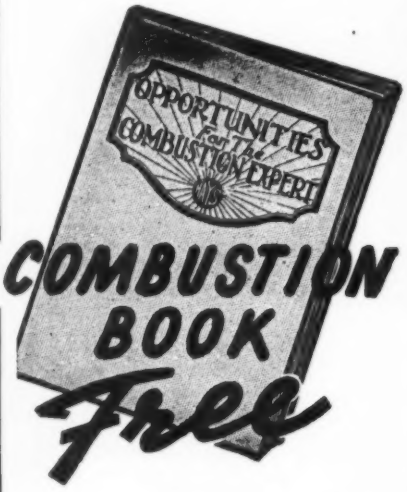
That is why war demands call for all we can make. But ALCO research goes on. After the war, still better ALCO Diesel Engines will open your eyes to new possibilities in power availability, versatility, and efficiency.

American Locomotive

ALCO DIESEL ENGINES

for Universal Application

30 Church Street, New York 8, N. Y.



COMBUSTION BOOK Free

Combustion efficiency as applied to Boiler Plant Operation, Fuels and Equipment is now a most important factor in Defense work. Fuels cost more than ever before. Boiler loads are heavier. A scarcity of some kinds of fuel is apparent.

The Combustion trained man—the Hays trained man — can do his part, and open up big opportunities for himself that never existed before, by devoting a little of his spare time in training himself to meet present conditions.

Just a Few of Our Hundreds of Friends

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Combustion Engineering Company 45
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State of Illinois.85
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How? Through the simple, easy reading, *practical* Hays Home Study Course in Fuel and Combustion Engineering. For 26 years the Hays Institute has specialized exclusively in training in Combustion Efficiency. Hundreds of Hays trained men now hold substantial positions of responsibility. What we have done for them we can do for you, in your spare time. Many companies urge their men to enroll. They know the value of Hays Combustion Training.

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GUIDES TO DEPENDABLE FUEL INJECTION EQUIPMENT

***by* ADECO**

- **Adeco Model PV — covers single unit fuel injection pumps with plunger diameters from 20 to 31 mm.**
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- **Adeco Fuel Injectors—presents the complete line of Adeco standard injectors and nozzle holders, including water-cooled type.**
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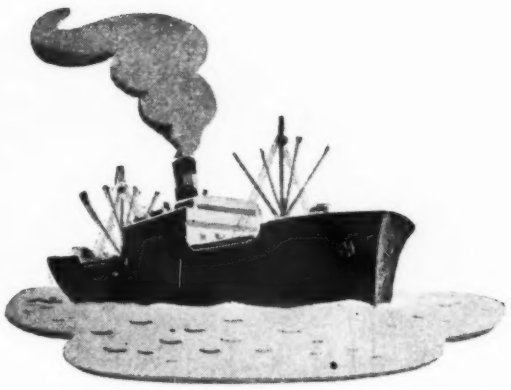
If you do not already have these helpful bulletins on Adeco fuel injection equipment, you can get them for the asking. The informative bulletins listed here present details on today's line of Adeco fuel injection pumps, nozzles, nozzle holders and nozzle testers.

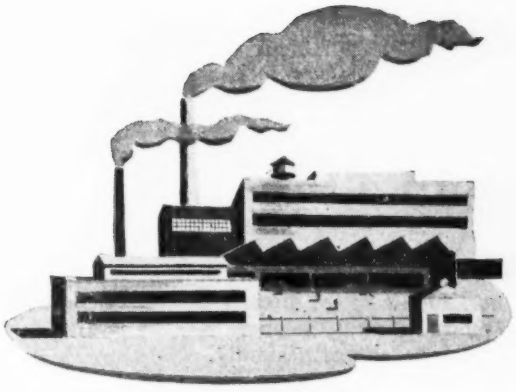
Write for them by name, or if you prefer, ask for complete catalog.

ADEC
AIRCRAFT & DIESEL EQUIPMENT CORP.
4401 NO. RAVENSWOOD AVE. • CHICAGO 40, ILLINOIS



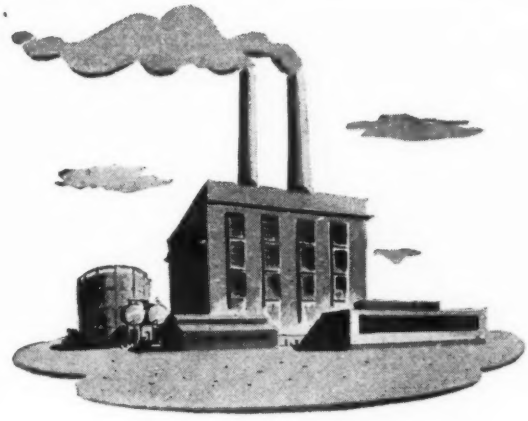
COOLER — CLEANER — LONGER LIFE

Early tube failure was traced to plug-type dezincification, with a change of metal indicated. But Scovill *Service in Metals* blamed unusually high temperatures and insufficient tube cleaning. Better operation lengthened life of replacement tubes many years.



LOCALIZED INFECTION CURED

Persistent failure of two rows of tubes in the first pass of a condenser was puzzling, because tubes in adjacent areas were normal. Scovill *Service in Men* helped the chief engineer work out an inexpensive construction change, ending the premature failure.



USEFUL TO UTILITIES

Scovill's Condenser Tube Booklet will be found in many a utility power plant — on industrial and marine engineers' desks, too — because it gives valuable information on metals, installation, analyzing trouble sources. It is part of Scovill's *Service in Manuals.*

Many power plant operators look first to Scovill for news on new developments . . . advice on installation practice . . . help in solving problems — because Scovill is

One Company Which Gives You

ONE PRODUCT

. . . Condenser Tubes

THREE SERVICES

For a free copy of the new Scovill Condenser Tube Booklet, write SCOVILL MANUFACTURING CO., 13 Mill St., Waterbury 91, Conn.

Long-distance control wastes time and labor in tube cleaning

Roto offers you operating control of tube cleaners where you need it most, right at the cleaner. An air valve, directly behind the Roto motor, permits the operator himself to turn air on and off instantly, eliminating the helper and saving time ordinarily lost by signalling. The advantages of Roto Tube Cleaners are particularly noticeable where a number of them are in simultaneous operation. Why not enjoy the time- and labor-saving features of Roto Tube Cleaners now, when you need them most?

ROTO TUBE CLEANERS

The ROTO Company
145 Sussex Ave., Newark 1, N. J.
A Division of Elliott Company

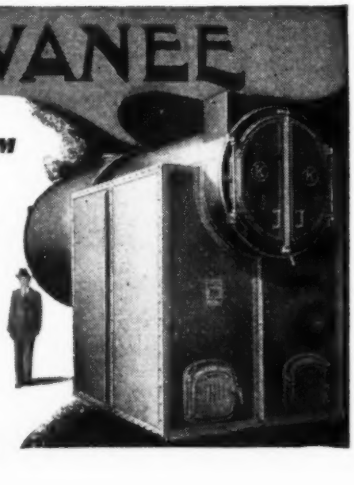
HI-TEST KEWANEE

FOR POWER and PROCESS STEAM

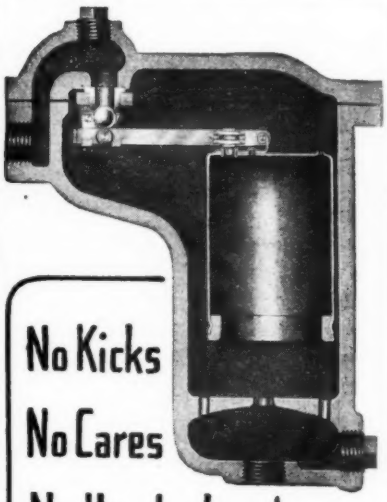
6 Sizes . . . 50 to 150 H. P. . . . 125 to 150 lbs. W.P. A quick steaming all-welded portable boiler with refractory lined firebox and 2-pass tubes to save fuel.

75 Years Boilermakers

For 6" scale with pipe diameter marking, write Department 89-K3.



KEWANEE BOILER CORPORATION
KEWANEE, ILLINOIS
Division of AMERICAN RADIATOR & STANDARD SANITARY CORPORATION



No Kicks
No Cares
No Headaches

"ALL'S WELL with CRYER TRAPS"

USERS of Cryer Traps actually wrote the headline of this advertisement. For example, here are a few of the comments on care-free performance under all conditions.

- . . . "three years' service without replacements"
- . . . "performance entirely satisfactory over a period of five years"
- . . . "cleaned only two or three times in three years"
- . . . "there has never been any sticking"
- . . . "need very little care"
- . . . "easily accessible for cleaning"
- . . . "like the air elimination of Cryers"
- . . . "for their capacity, bulk is less than other types"

Such remarks from users adds up to this, "All's well with Cryer traps".

The reasons for the superior performance of Cryer Bucket Steam Traps lie in the exclusive features of design which are fully described in illustrated literature available on request. Get all details on these man-power-conserving, dependable, easily installed traps, TODAY.

SPECIFICATIONS

Sizes ½" to 2½"
Capacities—500 to 38,000 lbs. water
Pressures—1 to 250 lbs.

We carry all sizes of traps and spare parts for the line formerly known as the J-M Ball Steam Trap.

CRYER TRAP & VALVE CO.

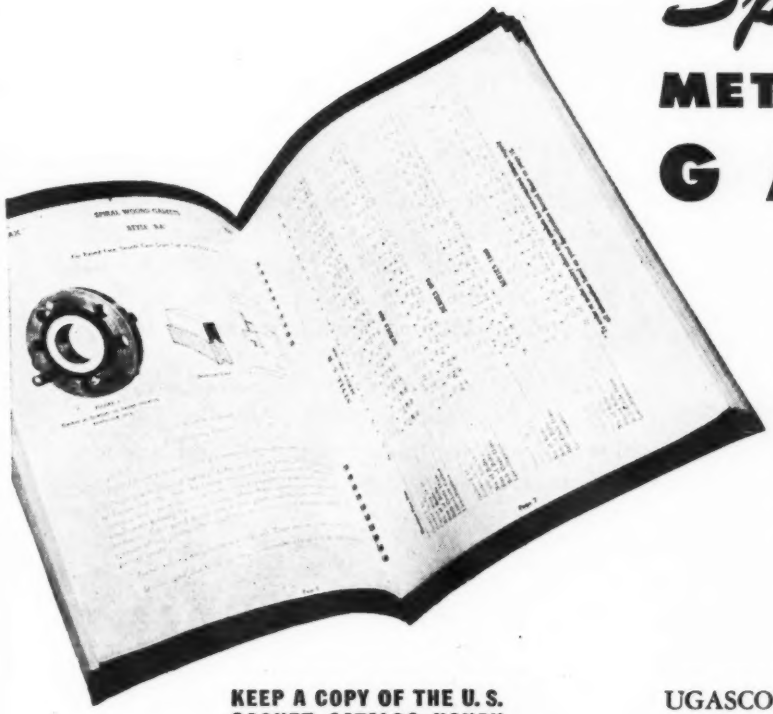
366 Madison Ave., New York, N. Y.

Manufacturers of steam specialties for over 45 years.

Spiral Wound

METAL and ASBESTOS

GASKETS



KEEP A COPY OF THE U. S. GASKET CATALOG HANDY

Revised, and up to date, this new catalog gives complete data, specifications, and other details of the Ajax line of gaskets. A copy is yours for the asking. Write today . . . no obligation.

Gaskets are cheap . . . until they fail in service, and then they're the most expensive item in the installation. So it's good insurance to know your gaskets and who makes them.

U. S. AJAX gaskets are produced by men who have over a quarter of a century of specialized gasket experience . . . men who have improved on gasket design and construction until there isn't a better gasket made for pressures from 10 psi to 3500 psi.

Here are the facts: AJAX gaskets are constructed of a single ply of metal, preformed in a U-shaped groove, and spiralwound from the inside to the outside. Between each metal ply there are inserted two parallel thicknesses of UGASCO Asbestos filler, one on either side of the U groove. A free air space . . . a "breather space" . . . between each thickness of filler assures that the gasket expands and contracts in relation to internal pressure change. AJAX Spiral Wound Gaskets are used wherever a sure seal is required in any pipe line or similar joint.

"THE GASKET THAT BREATHES"

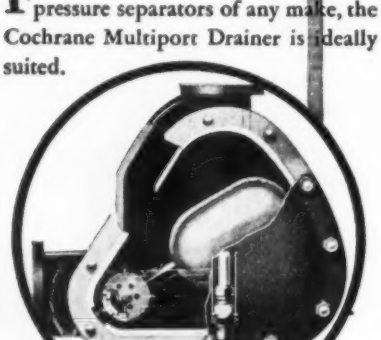
U. S. GASKET CO.

1592 PIERCE STREET, CAMDEN, NEW JERSEY

Separators

should be drained with COCHRANE *Multiport* DRAINERS

For handling the drainage of low-pressure separators of any make, the Cochrane Multiport Drainer is ideally suited.

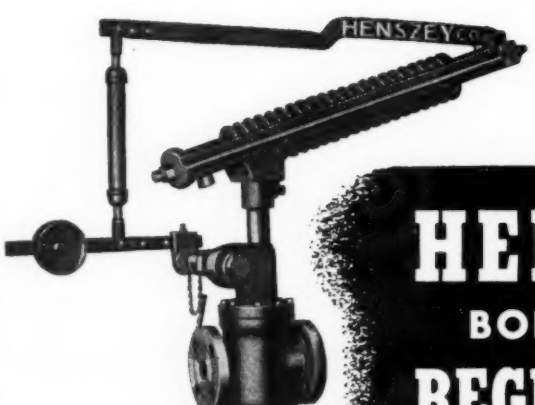


It is a Low-Pressure Steam Trap especially suited for operation at low differential pressures because of its very large port areas, providing tremendously large discharge capacity.

DISTINGUISHING FEATURES:
1. Cylindrical valve, absolutely balanced, makes possible use of large ports.
2. Valve never leaves its seat and is self-cleaning.
3. Only one moving element, self-contained in body—no stuffing boxes, links or springs.
4. Entire mechanism accessible—can be lifted out after removing casing cover.
5. Inlet at top prevents air binding—baffle prevents water hitting float.

Equip all your separators with Cochrane Multiport Drainers. *Write for Publication 2925.*

COCHRANE CORPORATION
3106 N. 17th Street, Philadelphia 32, Pa.



HENSZEY BOILER FEED REGULATORS on GUARD DUTY in an ORDNANCE PLANT *DAY after DAY* since 1942

Yes, in 1942 a large southern ordnance plant ordered 16 Henszey Boiler Feed Regulators for "guard duty" on vitally important boilers.

Henszey Regulators maintain proper boiler water levels continuously, automatically and accurately under all local conditions. They are easily installed right in the feed line—no additional supports are needed.

And did these Henszey Regulators do the job? You bet—so well that three more were recently added to the sixteen already in service.

Write for bulletin.

HENSZEY COMPANY

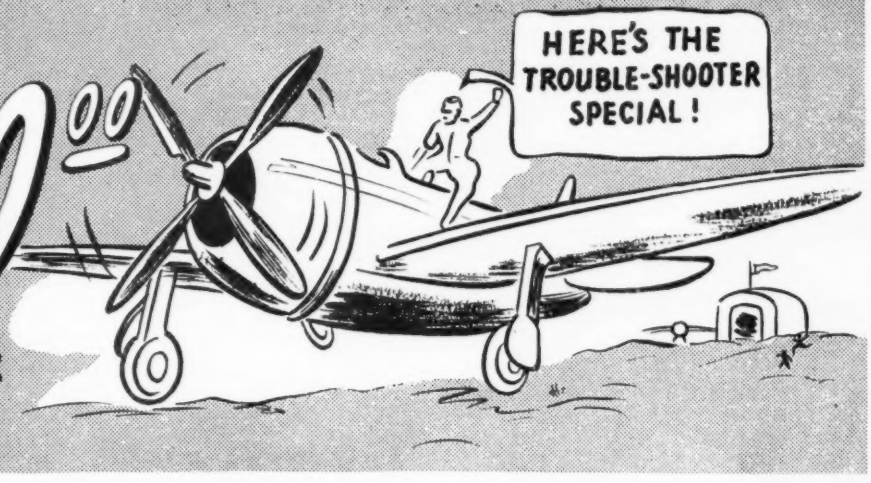
Dept. D3 • Watertown, Wis.

HENSZEY

BOILER FEED REGULATORS

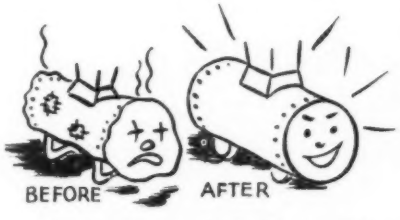
Continuous Blowdown • Distillation Systems • Heat Exchangers
Feed Water Meters • Flow Indicators • Proportioning Valves

HOW OUR FLYING *Trouble-shooter* *Saved* $30,000.00 For a Southwest Utility Plant



Another illustration of how Conseco Engineers give better, faster service on condenser repairs

This happened a few months ago, when a 35,000 sq. ft. condenser shell, a cast iron turbine casing and an exhaust trunk blew out in one of the largest utility plants in the southwest. After learning that the best delivery they could get on a new shell was 12 weeks, and that a new trunk and casing would take 16 weeks to build by the original manufacturer, they phoned Condenser Service.



One of our trained trouble-shooters flew down, made a careful check of the whole situation, and 20 hours later was on his way back. And within 18 days, all material needed to get this important central station going full tilt again was on its way.

Here's how we did it. We built a new shell 2 in. shorter than the old one, so we could use the old tubes and other serviceable parts of the old condenser, built a new exhaust trunk, and patched the old turbine casing in over 400 places.

Entirely apart from the fact that we saved him over $30,000.00 on this job, and got his plant going 90 days sooner than he expected, the vice-president of the plant was tickled with the patched turbine casing because it was so much more rigid than ever before.

Don't wait for a condenser breakdown to force you to shut down a vitally needed power unit. Plan your overhaul now, while you can schedule your shutdown off-peak. And for a workmanlike job —done when you want it—in the shortest possible time, call us, because:

We have the know-how—Our men are trained specialists. For 17 years we have been designing, building, modernizing and servicing all types and sizes of condensers and heat exchangers.

We have the facilities—Conveniently located shops, our own tools and techniques are all geared for faster, better servicing of condensers.

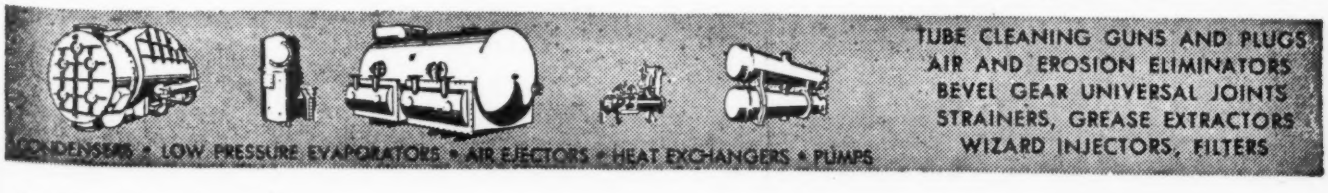
We never sleep — We operate on a 24-hour, 365-day-a-year schedule, which means that your job keeps moving every minute.

A wire or phone call will start your job rolling—on schedule or faster.

SERVICE — *A highly skilled, specially equipped service organization, ready for immediate action anywhere on the continent, backed by engineering and manufacturing facilities producing over 3,000,000 sq. ft. of heat exchangers annually.*

CONDENSER SERVICE & ENGINEERING CO., INC.

81 RIVER ST., HOBOKEN, N. J. Phone—HOboken 3-4425 After 6 P.M. or Sundays—HOboken 3-4428


CONDENSERS • LOW PRESSURE EVAPORATORS • AIR EJECTORS • HEAT EXCHANGERS • PUMPS
TUBE CLEANING GUNS AND PLUGS
AIR AND EROSION ELIMINATORS
BEVEL GEAR UNIVERSAL JOINTS
STRAINERS, GREASE EXTRACTORS
WIZARD INJECTORS, FILTERS

The Improved FREDERICK STOKER

. . . DESIGNED to get every bit of heat from every ton of coal . . .

We have been stoker specialists since 1918. The improved FREDERICK Stoker line is the foremost stoker value in America because

- V the fully active grate surface
- V continuous speed type transmission
- V completely enclosed windboxes and mechanism

plus other FREDERICK engineered features,* give maximum combustion efficiency with minimum service and maintenance—and result in lowered fuel consumption.

*Our Stoker catalog enumerates additional reasons why you should use FREDERICK Stokers. Send for your copy . . . today.

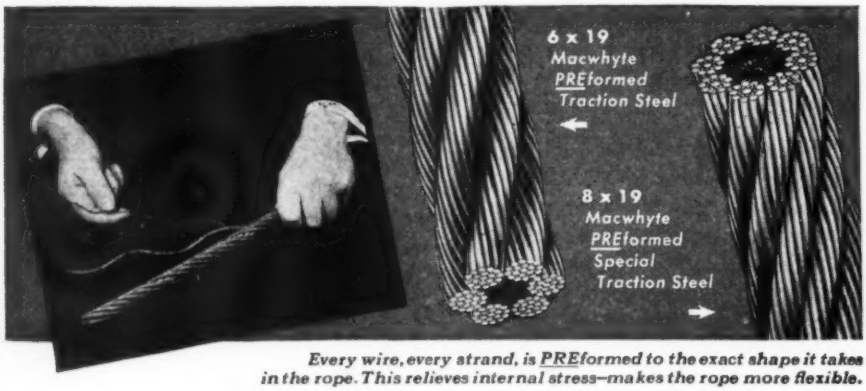
Hopper and Bin Feed
Models; 200 to 850 lb. per hour. Clinker Type or Side Dumping Grate.

ALSO KEEP IN MIND

—for over 25 years FREDERICK has been making fine Centrifugal Pumps, guaranteed to meet the operating conditions for which they are sold. Write for full information.

THE Frederick IRON & STEEL CO.
Frederick, Maryland

STOKER SPECIALISTS SINCE 1918



Every wire, every strand, is PREformed to the exact shape it takes in the rope. This relieves internal stress—makes the rope more flexible.

Specially Designed for Elevators

Macwhyte PREformed Elevator Ropes are made from tough, flexible wire found by years of experience to be best for elevator service. The correct lay and combination of wires are used to keep stretch at a minimum, yet make the ropes as flexible as possible to withstand bending fatigue. Flexibility is further improved by Macwhyte Internal Lubrication, which keeps individual wires and strands free to move as they bend around sheaves and drums.

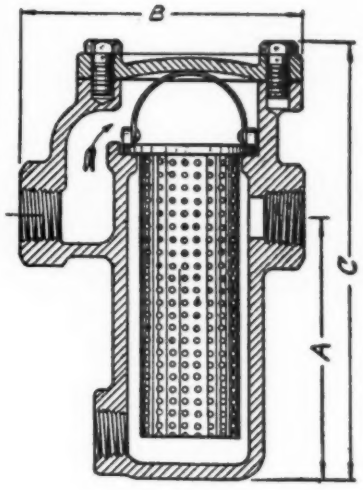
MACWHYTE COMPANY
2944 Fourteenth Ave., Kenosha, Wisconsin

Specify Macwhyte PREformed Elevator Ropes to your maintenance man

NO. 787-E

MACWHYTE
PREformed ELEVATOR ROPES
The CORRECT Ropes for your Equipment

EDCO STRAINERS



BASKET TYPE FOR VARIOUS FLUIDS

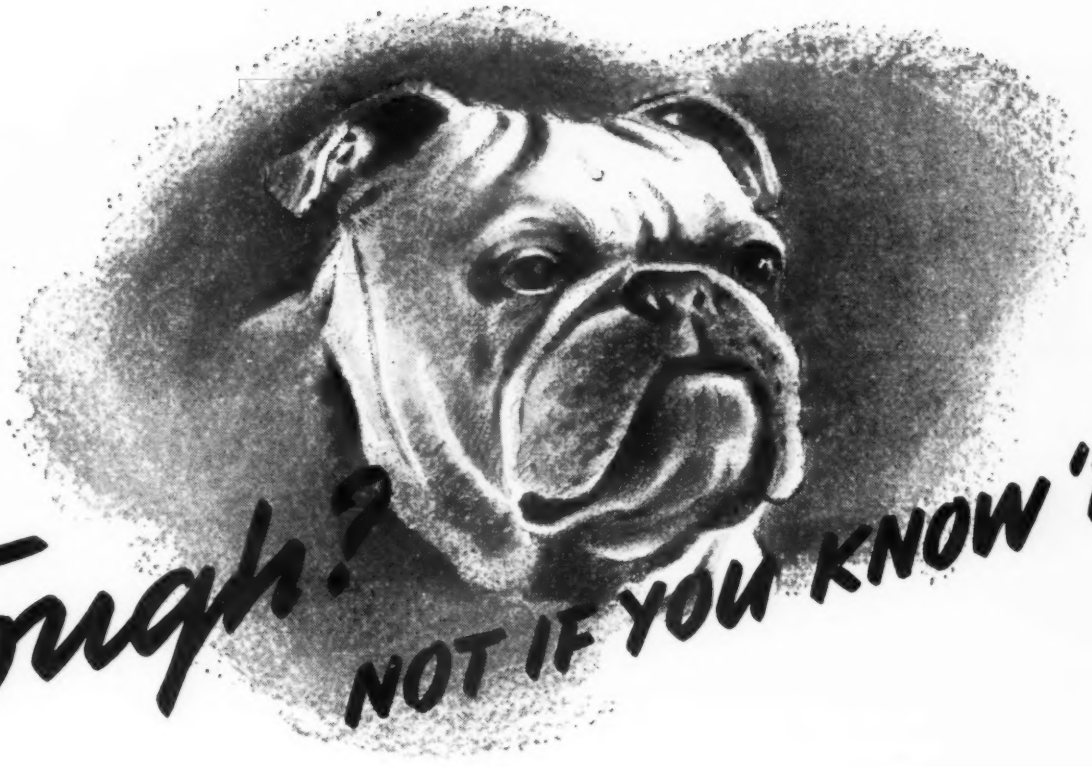
The EDCO basket type strainer is used extensively on suction and pressure pump lines carrying water, oil and other fluids.

The baskets are made from either brass or steel screens or perforated sheets, depending on the nature of the operation.

EDCO Strainers are easily removed for cleaning by the handle attached to the basket. The body and cap are cast bronze but can be made from steel or semi-steel, threaded or flanged.

EDCO makes strainers for steam—air—gas and fluids. Write today for detailed data on these products. They offer you many savings. Ask for Bulletin 863.

EDDINGTON METAL SPECIALTY CO.
P. O. BOX K EDDINGTON, PA.



Tough? NOT IF YOU KNOW 'EM!

Engineering problems are something like bull dogs. If you don't know how to handle them they're tough . . . mighty tough. But if you have the know-how there's no question as to who is the master—you or the problem.

J. F. Pritchard and Company engineers have the know-how for solving and executing the more perplexing problems. Their experience in designing, engineering and constructing some of the most outstanding projects during the past several years is definite proof of their unchallenged ability.

Petroleum—Chemical—Petro-Chemical—Natural Gas—Power—Cooling Towers—no matter what the job, Pritchard Engineers can be of *real* service to you . . . today and tomorrow . . . for what they do today is dependable tomorrow. J. F. Pritchard and Company, Fidelity Building, Kansas City 6, Missouri.

KANSAS CITY
TULSA
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Pritchard

HOUSTON
NEW YORK
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ENGINEERS AND CONSTRUCTORS
FOR THE CHEMICAL • PETROLEUM • GAS AND POWER INDUSTRIES
Manufacturers of Mechanical and Atmospheric Cooling Towers

71 Ways to expedite POWER PLANT MAINTENANCE

Busy engineers and superintendents responsible for power plant maintenance will welcome the newly-revised and enlarged Oakite Digest describing 71 commonly-recurring cleaning, descaling, derusting operations.

They will find much valuable data on a wide range of plant maintenance tasks such as paint stripping, reconditioning exterior painted surfaces, cleaning heat exchangers, Diesel cooling systems, Diesel lube and fuel oil filters, lube oil coolers and oil preheaters.

Techniques Are Time-Tested!

This factual Oakite Digest has been compiled by condensing the successful, current experiences of over 300 power plants . . . the Oakite techniques set forth have stood up under long and grueling tests . . . they will help you to save time and money by reducing equipment out-of-service time.

FREE copy gladly sent on request. Write TODAY!

OAKITE PRODUCTS, INC.
23 Thames St., NEW YORK 6, N. Y.

Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE *specialized cleaning*
Buy Bonds for Victory
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

Still available!

MAGNOLIA ANTI-FRICTION BEARING METAL

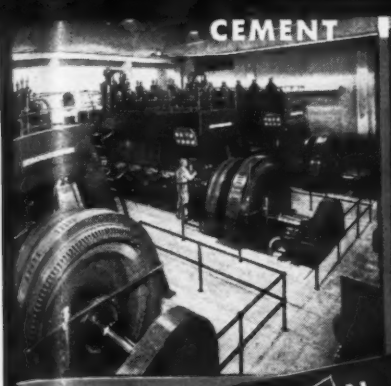
In the last two years many bearing metals have disappeared from the market. But MAGNOLIA ANTI-FRICTION METAL is still available.

And, furthermore, its composition remains unchanged. It is still the same graphite-treated, self-lubricating alloy having the lowest coefficient of friction of any known bearing metal — 300% lower than genuine babbitt.

The next time bearings need relining, why not use this well known, widely accepted metal? Your local distributor carries MAGNOLIA ANTI-FRICTION METAL in stock for immediate delivery.

MAGNOLIA METAL CO. • ELIZABETH 4, N. J.

MAGNOLIA BEARING METALS

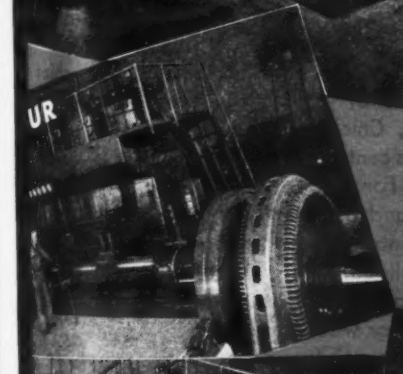


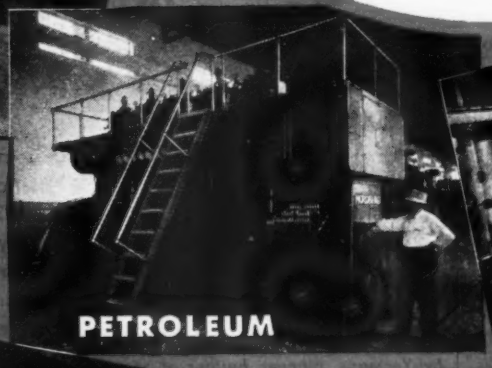
Low cost, dependable

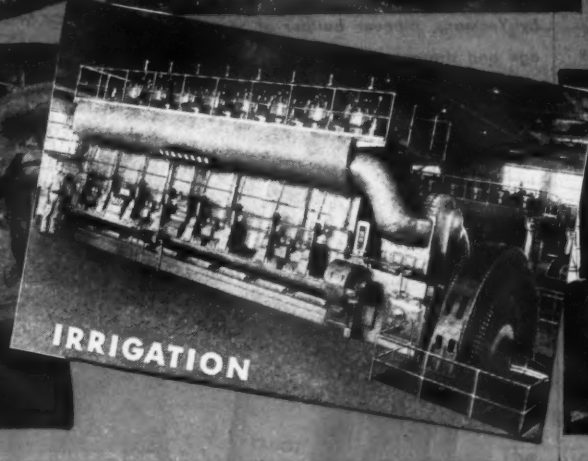
NORDBERG DIESEL POWER

Here are a few of the many applications for which Nordberg Diesels supply power. If your future plans include a new power plant or an addition to your present power facilities, investigate the merits of Nordberg Diesel power.

NORDBERG MFG. CO.
Milwaukee 7, Wis.







NORDBERG
DIESEL ENGINES

Stop it with RANAREX*

It's easy to stop wasting power with Ranarex. Just measure the CO_2 in flue gases with this instrument and you can regulate combustion to the exact point at which you get the most power possible from the fuel consumed. You eliminate guesswork, stop wasting fuel. Users report big savings—up to 20%.

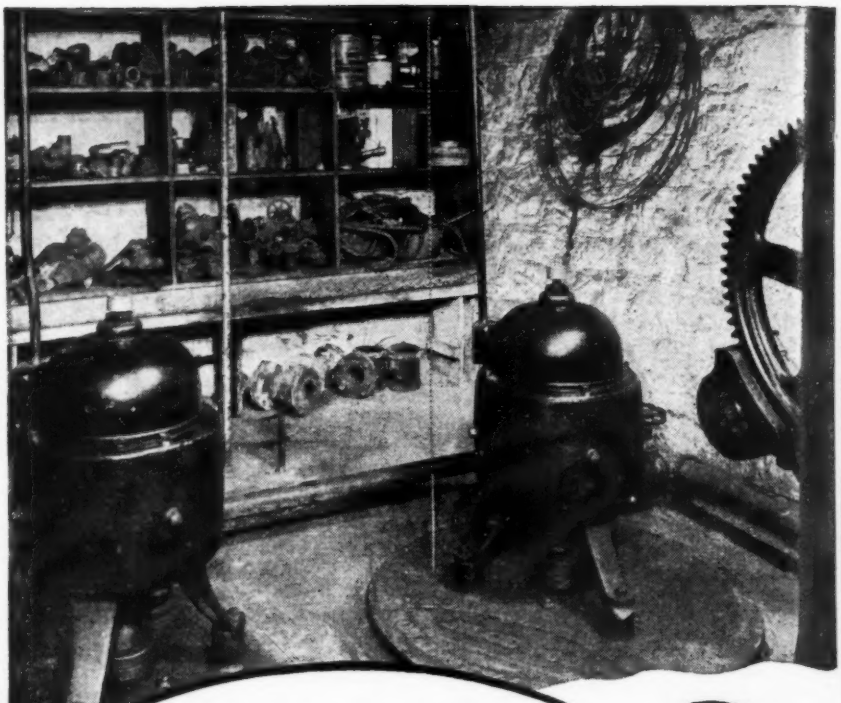
Anyone can operate Ranarex. It's so simple it can be taken apart with a screwdriver. It's the only all-mechanical CO_2 indicator and recorder—contains no chemicals or fragile parts to get out of order. Yet it gives almost instant readings, accurate to within 3/10 of 1%.

Get full details about this amazing fuel-saver now! Write to The Permutit Company, Dept. A, 330 W. 42nd St., New York 18, N. Y. In Canada: Permutit Company of Canada, Ltd., Montreal.

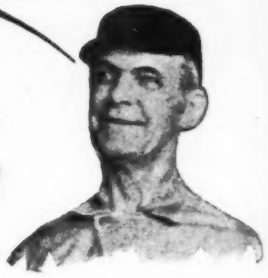
* Trademark Reg. U.S. Pat. Off.

"CUTS HEAT LOSS UP-THE-STACK"

product of PERMUTIT



Hello, Yeomans— does your guarantee cover pumps installed in 1902?



THIS call from Paul Zimmerman, chief engineer of Wilson Brothers Company building, Chicago, concerned one of two Yeomans centrifugal wet pit ejectors installed in 1902. For 42 years they had been tending quietly and efficiently to their job of pumping drainage, seepage and toilet wastes. Rust finally ate through the suspension pipe of one pump and attacked the impeller. A new ejector was installed.

Such records are not uncommon for Yeomans Pumps—are, rather, the usual thing. Yeomans Pumps are engineered and built to deliver just such service. This dependability you can take for granted is characteristic of all Yeomans products.

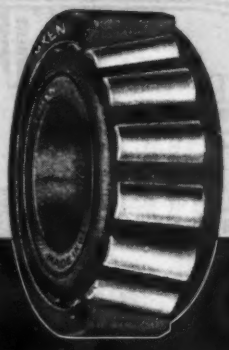
***New* . . . IMPORTANT FOR YOUR DATA FILE:**

Bulletin 3003 gives full details on the new submerged pump design developed by Yeomans, pioneer builder of sewage and drainage pumps.

YEOMANS PUMPS • GIVE YEOMAN SERVICE •

Yeomans Pumps

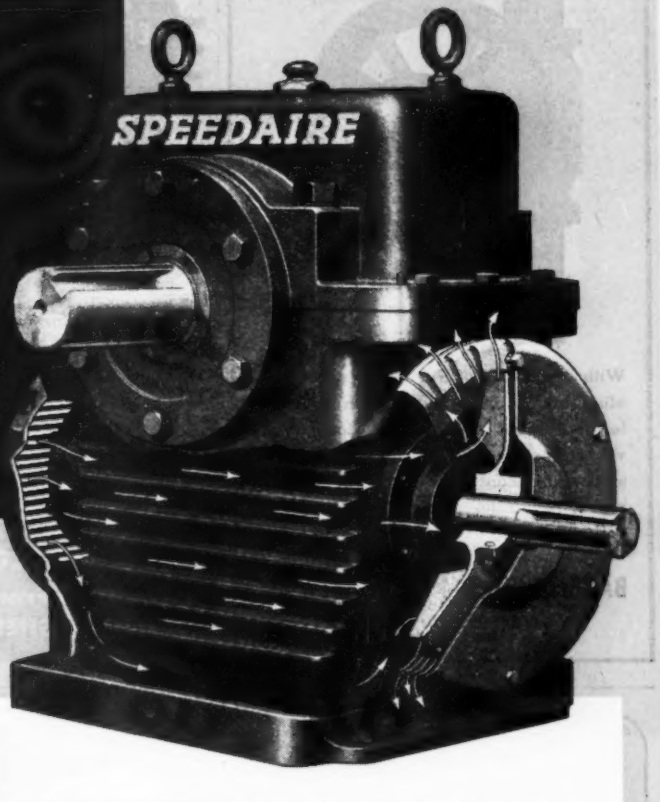
YEOMANS BROTHERS COMPANY
1446 North Dayton Street, Chicago 22, Illinois

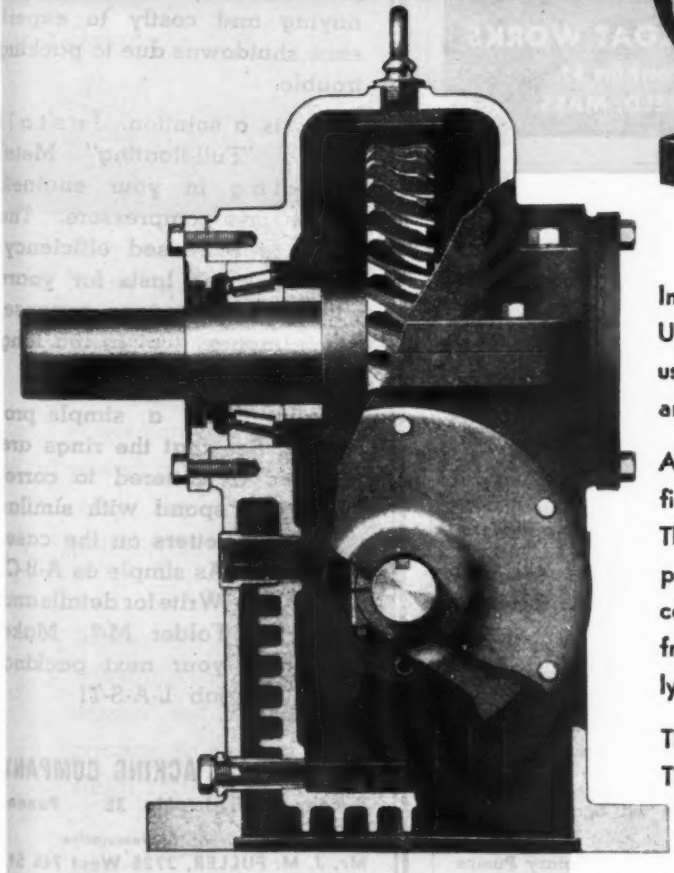


TIMKEN BEARINGS

Tapered Roller TIMKEN BEARING EQUIPPED

help Cleveland SPEEDAIRE transmit more H.P. per dollar cost





In their new "Speedaire" Worm Gear Reduction Unit, the Cleveland Worm and Gear Company uses fan-cooling to reduce operating temperatures and thereby increase power transmission capacities.

Additional efficiency is provided by mounting the final drive shaft on Timken Tapered Roller Bearings. This assures constant shaft and gear alignment; protects the worm gear against radial, thrust and combined loads; and eliminates power loss through friction. Thus "Speedaires" can do work that formerly required larger units.

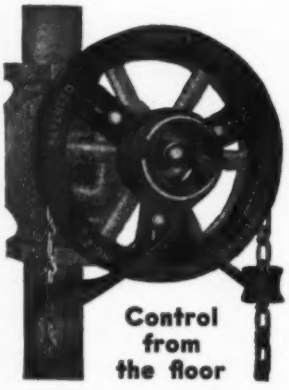
The Cleveland Worm and Gear Company has used Timken Bearings in their standard units for years; has proved that it pays — and so have users of Cleveland equipment. Make sure you have them in your new gear reduction units. And see that the trade-mark "TIMKEN" is on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN

TRADE MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

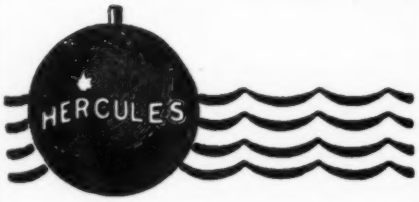
Make Your Overhead Valves SAFE And Easy to Reach---



With the Babbitt Rim for Valves you eliminate danger and banish the step ladder. You can now place your valves wherever they come economically and conveniently. They fit any valve. Let us tell you more about them. Write today.

BABBITT STEAM SPECIALTY CO.
New Bedford, Mass.

HERCULES
Seamless Copper
FLOATS



GUARANTEED TO STAND UP!

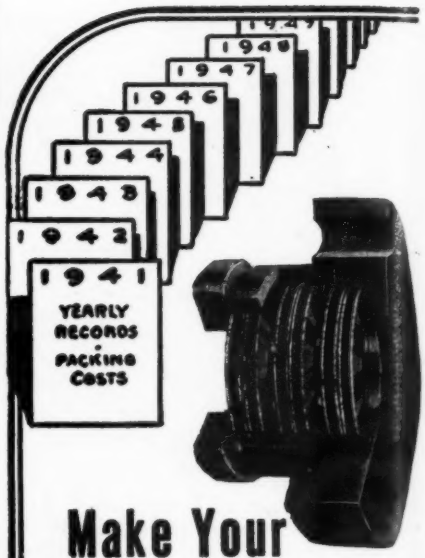
Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

Fabricated of seamless copper under our special spinning process. Hercules Floats are uniform in thickness and high in mechanical strength.

You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service.

Insure care-free maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

HERCULES FLOAT WORKS
200 Franklin St.
SPRINGFIELD, MASS.



Make Your Next Packing Job *L-A-S-T!*

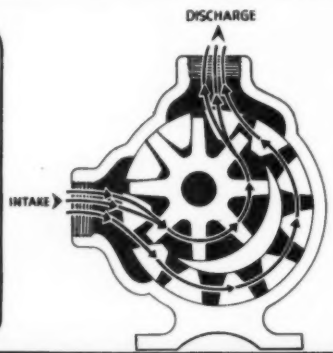
During these days of increased production, it is especially annoying and costly to experience shutdowns due to packing trouble.

There is a solution. Install France "Full-floating" Metal Packing in your engines, pumps and compressors. The result is increased efficiency. And each job lasts for years without maintenance expense. Saves money, too, in the long run.

Installation is a simple procedure. See that the rings are installed as lettered to correspond with similar letters on the case. As simple as A-B-C. Write for details and Folder M-7. Make your next packing job L-A-S-T!

THE FRANCE PACKING COMPANY
Tacony Philadelphia 35 Penna.
Mid-Continent Representative:
Mr. J. M. FULLER, 3725 West 7th St.
FORT WORTH, TEXAS

Another Reason Why VIKING Is The LARGEST SELLING ROTARY PUMP IN THE WORLD



BY OPERATING THE VIKING PUMP IN THE OPPOSITE DIRECTION THE FLOW OF LIQUID WILL BE REVERSED

Viking Rotary Pumps are designed and built to deliver liquids with a smooth, even flow . . . without pulsation or pounding.

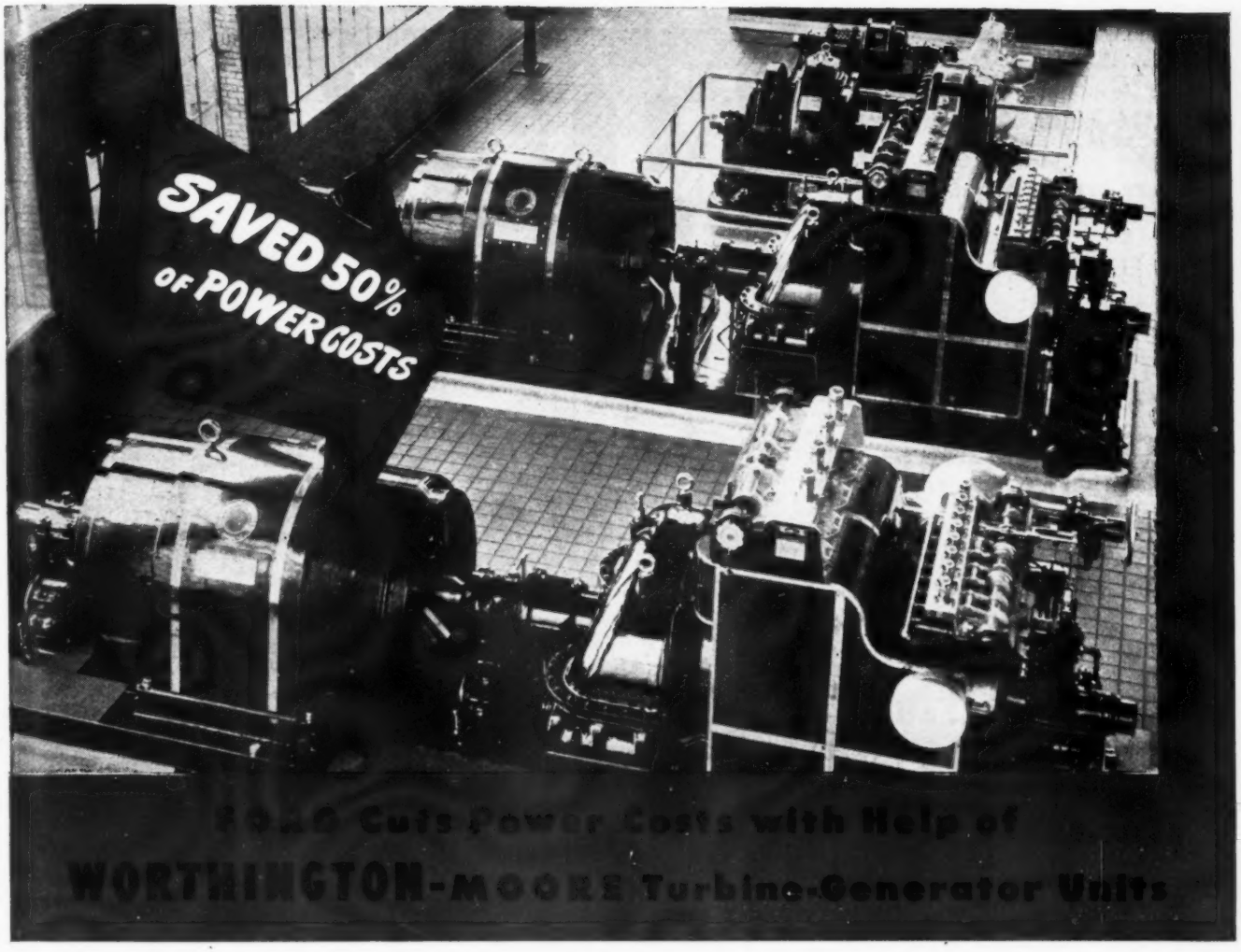
"Smooth as silk" performance is assured because Vikings work with no reverse motion to create turbulence. With a Viking, the liquid enters your pump through an oversize orifice, travels in a curve three-quarters of the way around your pump, and is then discharged. Vikings will operate equally well in either direction.

For complete information about Viking Rotary Pumps widely used in the power equipment field, write today for Bulletin 800. It will be sent free by return mail.

VIKING PUMPS — FIRST IN AMERICA

VIKING Pump COMPANY
CEDAR FALLS, IOWA

Original FRANCE METAL PACKING



Power costs have gone down 50% in the Ford Motor Company's Chicago power plant near the Calumet River. This is another example of how *modern* automatic extraction type turbines can cut power costs, far below costs of older methods of power generation. Superintendent reports "excellent service record during the period since installation with no interruption."

Engineered to Fit the Job

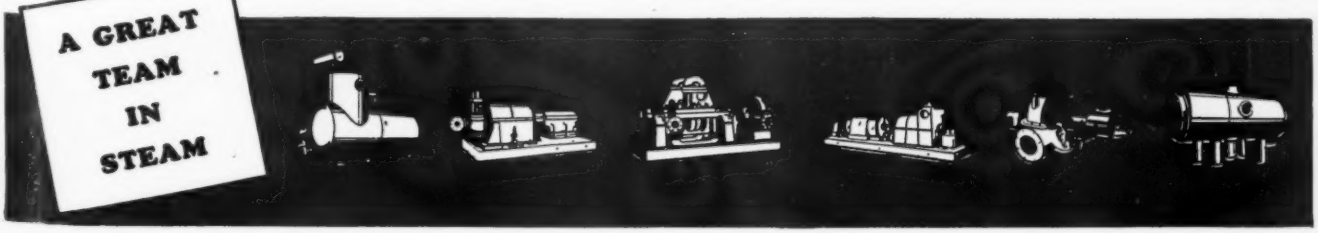
Taking 225 lb. 525° steam at the throttle, the Worthington-Moore turbines exhaust to the condensers, and automatically extract steam at 5 lbs. pressure to satisfy variable process and heating steam requirements.

Investigate WORTHINGTON-Moore Teamwork

In many other turbine-generator installations, firms like yours have profited from Worthington's broad experience with steam power plant equipment, plus Moore's years of turbine engineering and manufacture. Write us, or call our nearest district office. *Worthington Pump and Machinery Corporation, Moore Steam Turbine Division, Wellsville, N.Y.*

WORTH BEHIND THE NAME
WORTHINGTON

MR 4-8



C. H. WHEELER OF PHILADELPHIA

STEAM CONDENSERS

•

AIR EJECTORS

•

MECHANICAL DRAFT COOLING TOWER

•

DECK MACHINERY

C. H. WHEELER MANUFACTURING CO.

19th St. & Lehigh Ave.
Philadelphia 32, Pa.

The **MOST PUMP** *in least Weight & Space*

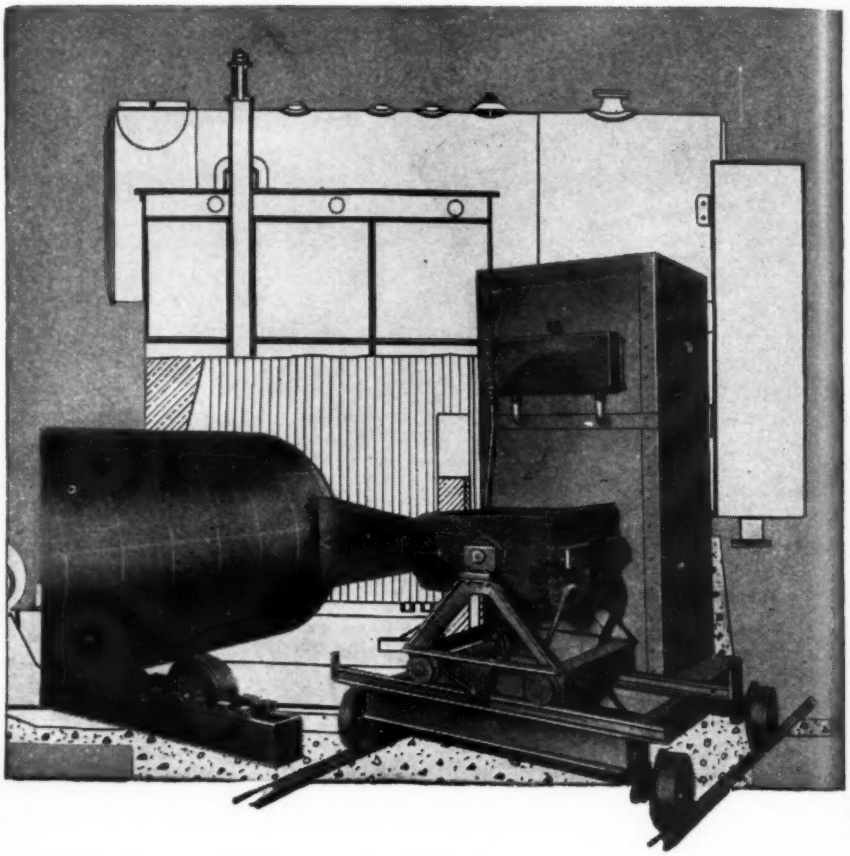
IMO
I MOVE OIL

The De Laval-IMO pump for fuel oil and "lube" oil services is distinguished by compactness and simplicity. There are only three working parts which are in complete hydraulic and rotational balance and which propel the oil without pulsation, like a piston moving steadily forward. There are no valves, no gears, no cams and no reciprocating parts. The one packing is on the suction pressure only and is easily accessible. Any quantity of oil is delivered against any pressure.

Ask for Publication I-111

IMO **PUMP DIVISION**
of the De Laval Steam Turbine Company
Trenton, New Jersey

UNION



COUNT UNION as a reliable source of pressure vessels and fabricated steel built to your specifications. Illustrated above is one method of inspection — the X-Ray. Magnaflux inspection is regularly used complementing X-Ray or Gamma Ray inspection as a further check on either of these methods. Union is prepared to meet any specified inspection routine that your service demands. Write for Booklet 117 to get better acquainted with Union's enlarged facilities. Send us your inquiry.

UNION IRON WORKS ★ ERIE, PA ★

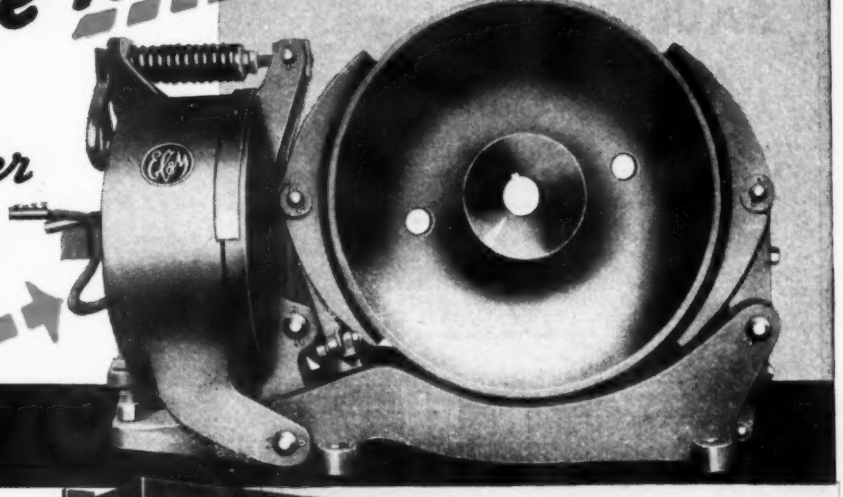
BOILERS

PRESSURE VESSELS • PLATE FABRICATION

TYPE WB BRAKE

Solves the A-C BRAKE Problem

....gives better PERFORMANCE too...



Rectifier - Unit in compact form for separate mounting on existing installations.

MANY users of a.c. motor-driven cranes, hoists and machinery are switching to the EC&M Type WB Brake with rectifier-unit. Its *high-speed performance* and *reduced up-keep* for a.c. circuits have prompted its nationwide acceptance. Repeat orders indicate standardization on the WB Brake wherever a.c. brakes are needed.

These brakes not only eliminate the laminated members required in a.c. brake design, but give quick response. High initial current insures *fast release;* automatic reduction of the holding current results in *fast setting.*

The rectifier-unit is compact and is arranged for separate mounting for existing installations. On new projects, it may be combined with the motor control panel. Bulletin 1006 gives complete details on WB Brakes for- a.c. operation. Bulletin 1004-D describes them for d.c. service.

THE ELECTRIC CONTROLLER AND MANUFACTURING CO.

2698 East 79th Street **Cleveland 4, Ohio**

REDUCED UP-KEEP *and* BETTER OPERATION

because

No laminated magnets or plungers.
No destructive hammer-blow.
No a.c. chatter.
No coil burn-out due to shoe-wear affecting air-gap.
No motors, gears or pumps.
Has fast release and fast set.
Has ability to permit accurate inching.
Has hand release.
Has solid cast-steel magnet and armature.
Has short armature-movement.
Has thick, molded brake blocks 1/4" to 3/4" thick.

On Cranes, Hoists and Machinery ...the EC&M Type WB Brakes *give* HIGH SPEED PERFORMANCE —REDUCED UP-KEEP

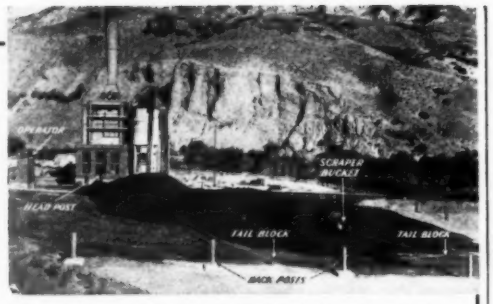
STORE and RECLAIM YOUR COAL *the*

Better, Safer Way

with a

SAUERMAN

One-Man SYSTEM



Above is a small Sauerman Scraper System arranged for hand shifting of tail blocks. The picture was taken soon after machine was installed and accordingly shows only the start of the stockpile which eventually covered the entire storage area to a height of 15 ft. and contained about 25,000 tons of coal.

IT WILL PAY YOU to investigate Sauerman Power Drag Scraper Systems for storing and reclaiming coal.

You can save labor for these systems move coal to and from any point in the storage area under virtual "push-button" control of a single operator.

You can save space for a Sauerman machine stores maximum tonnage on any available area.

You can avoid unnecessary hazards for a Sauerman machine builds a pile that is homogeneous, compact and safe.

You can save money for users' records show average maintenasce costs of only a fraction of a cent per ton of coal handled. Installation cost is surprisingly small.

At hundreds of plants Sauerman Systems are doing a better, safer, cleaner job of storing and reclaiming coal. They can serve you equally well.

SAUERMAN ADVANTAGES:

- One-man operation
- Maximum use of space
- Greater safety
- Low-cost equipment
- Upkeep simple
- Adjustable range.

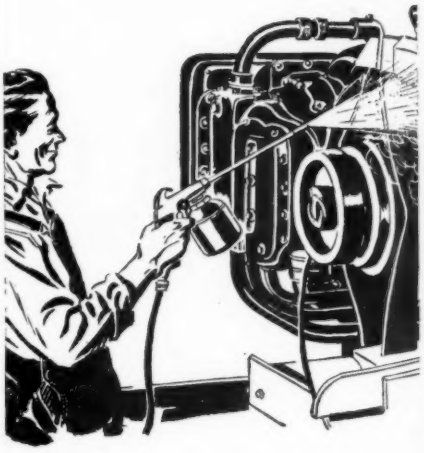
Our Catalog is yours for the asking

SAUERMAN BROS., Inc.

562 CLINTON ST., CHICAGO 7, ILL.

RUST

CAN'T TOUCH TECTYL-PROTECTED METAL



The Thin Film SEALS out moisture

In either fresh or salt water atmospheres, metal surfaces covered with one quickly applied coat of Tectyl are protected for as long as two years. The Tectyl film is transparent, so you can inspect the metal at any time. It's easy to put on by spraying, dipping, brushing or flushing, easy to take off with kerosene, and in many cases need not be removed at all.

Five Specialized Types

Tectyl can increase the useful life of your equipment, whether indoors or out, whether in operation or in storage. WHATEVER your need may be—there's a special Tectyl product that will save you money and man-hours. Tectyl gives you economical, *positive* protection. Write today, telling us your corrosion problem, and we'll send you our Tectyl bulletin with complete application data.

TECTYL *STOPS RUST*

VALVOLINE OIL COMPANY

547 East Fifth Street Cincinnati 2, Ohio

Refinery at Butler, Pennsylvania

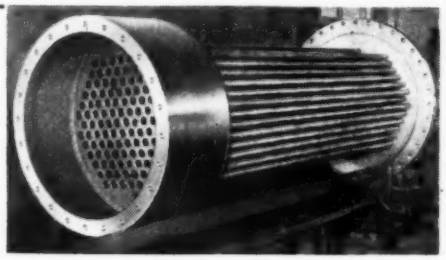
General Offices, Cincinnati, Ohio

New York - Atlanta - Detroit - Chicago - Los Angeles

Vancouver - Washington, D. C.

DOWNINGTOWN LEADERSHIP

in Stainless Steel Heat Exchanger Design and Fabrication . . .



Tube bundle of Calandria. All stainless 316 (18-8SMO). Note details of welded floating tube sheet.

A Downingtown built stainless steel heat exchanger has these advantages—

V Two of the major sources of stainless steel material are practically in our neighborhood.

V Downingtown is a pioneer in stainless steel fabrication; the first large job in the United States was Downingtown built.

V Downingtown design engineers approach stainless steel design from the practical standpoint—long experience in handling this material has made them familiar with its uses as a fabricatig medium.

V In fabricating equipment where various grades of stainless steel are used or when a grade of stainless steel is attached to other metals, Downingtown's experience and knowledge may prove most helpful to you.

It will be to your advantage to let us figure on your next stainless steel job . . . engineering consultation always available.

May we send you our heat exchanger bulletin? Send for it today . . . on your letterhead, please.

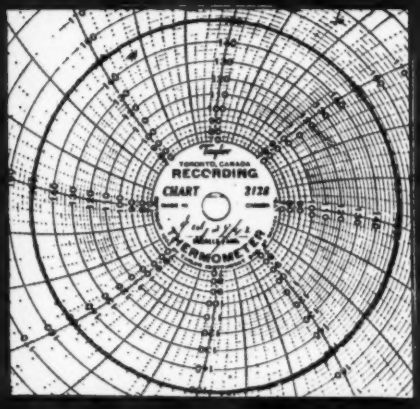
DOWNINGTOWN IRON WORKS

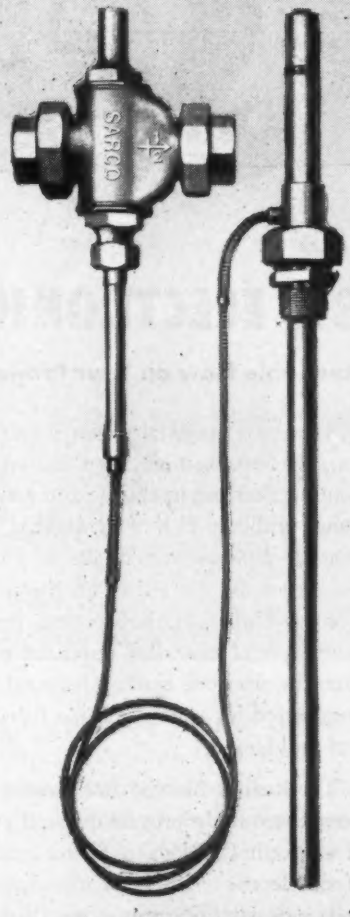
DOWNINGTOWN, PA.

HEAT EXCHANGERS

KEEP TEMPERATURES

in line!



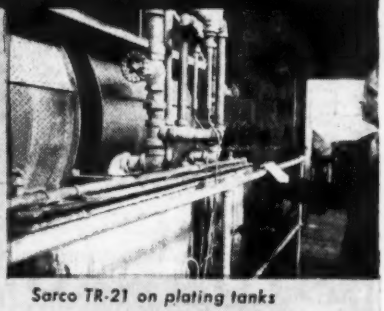


Sarco TR-21 Temperature Control

A malting company "increased its capacity 25%." Enameling was "placed on an assembly line basis." A match plant "eliminated danger of explosion." A textile plant obtained "greater output, more work at less cost" and a chemical plant "saved 90% of their vacuum pump cooling water." All statements of fact by users of Sarco temperature control. All because without Sarco control their temperatures had been "off the line."

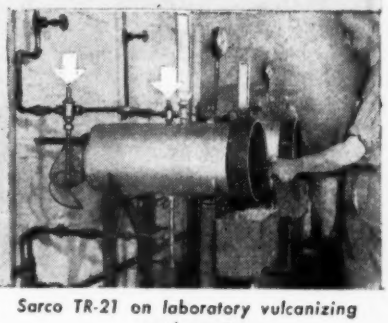
The illustration shows one of a complete line of self-operated thermostatic regulators for temperatures 0-400° F. These simple and sturdy instruments are standard equipment on hot water heaters of all types, and are used in industry to maintain constant temperature in all types of process equipment. Thermostatic element is of the liquid expansion type. No stuffing boxes to stick or leak. Valves are equipped with packless seals. This is only one of the many Sarco heating and cooling controls.

We can't imagine what your control problem is but the chances are, we have already solved one like it. Let us help you keep temperatures on the line. Ask for Catalog 600.



Sarco TR-21 on plating tanks

Sarco TR-21 on storage water heater



Sarco TR-21 on laboratory vulcanizing equipment

33

SARCO COMPANY, INC.
475 FIFTH AVENUE
NEW YORK 17, N. Y.

Represented in Principal Cities

SARCO Saves Steam

SARCO CANADA, LTD., 85 Richmond Street, West, TORONTO, ONTARIO

3-in-1

BLOW—CLEAN—SPRAY with TORNADO

With its 1 h. p. G. E. motor, TORNADO Portable Electric Blower blows dust, dirt and lint out of motors, generators, shafting, etc. With bag and attachments added, it is convertible into a Vacuum Cleaner, for cleaning shelves, bins, floors and light salvaging. With other attachments, it can be made into a Sprayer, for spraying insecticides. Keeps equipment and plant clean for increased production and lower costs. Saves power—reduces hazards—lowers upkeep.

Request details and FREE TRIAL Offer

BREUER ELECTRIC MFG. CO.
5114 Ravenswood Ave., Chicago 40

TAKE THE DUST OUT OF DUST WITH TORNADO
PORTABLE ELECTRIC BLOWER

ADAMANT
FIRE-BRICK CEMENT

. . . WELDS BRICKWORK TOGETHER

Use ADAMANT for strong, gas-tight joints that will not shake loose from vibration and will effectively resist the abrasive action of dust laden gases . . . for strong, thin joints that are as strong as the brick they bond. Longer life of furnace linings means savings in maintenance costs.

"Its Strength Increases as Temperature Rises"

ADAMANT has a bonding strength of 800 pounds per square inch at room temperature and 1270 pounds per square inch at 2600° F. ADAMANT has a P. C. E. of 3000° F. Plus.

This exceptional bonding strength is the reason why ADAMANT keeps furnace linings in service longer. Write for further details.

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REFRACTORIES COMPANY

784 S. Swanson St., Philadelphia 47, Pa.
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STOP FISH

BY ELECTRONICS

Available Now on Your Property

This patented fish control method employs modern electronics in overcoming a serious operating and maintenance problem. Fish of all sizes are kept at a *safe distance* from intake structures, or screens, by the use of an Electronic Control Unit. This equipment, generating special electrical impulses, energizes an electrode system designed and engineered for your particular fish control problem.

The Burkey Electric Fish Screen has been thoroughly proven through years of service in Condensing Water Intakes, Hydroelectric Plants, Water Systems and Industrial Pumping Installations. DOES NOT STUN OR KILL FISH.

Recommended by State Conservation Officials.

Free literature and quotations upon request.

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Hollywood 46, California

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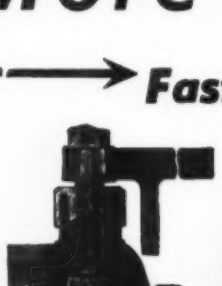
NICHOLSON TRAPS & VALVES

DELIVER

More Power to You

BECAUSE OF THEIR

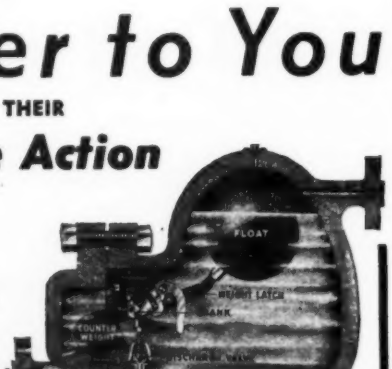
Fast, Positive Action



NICHOLSON CONTROL VALVES—Many types for air, steam, oil, gas, tar, water, etc. Pressures to 5000 lbs. Catalog 543.

★

NICHOLSON THERMOSTATIC STEAM TRAPS—5 types; sizes ¼" to 2"; pressures vacuum to 225 lbs. Bulletin 843.



NICHOLSON HEAVY-DUTY TRAPS—Weight-operated, piston-operated, compressed air and gasoline traps for all pressures in power and process applications. Time-tested. Catalog 444.

Nicholson Traps and Control Valves—widely recommended by engineers because of the way they speed steam circulation and thus increase applicable power—are made for practically every power and process application. Send for bulletins listed above, or see our catalog in Sweet's.

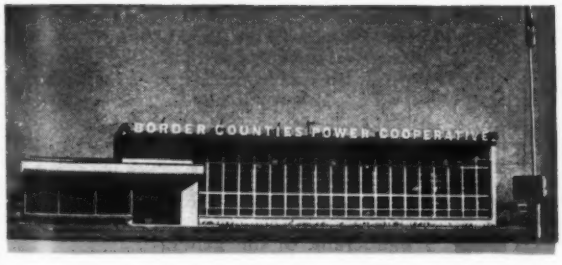
W. H. NICHOLSON & CO. 125 OREGON ST. WILKES-BARRE, PA.

HOW TO PUT WASTE HEAT TO WORK

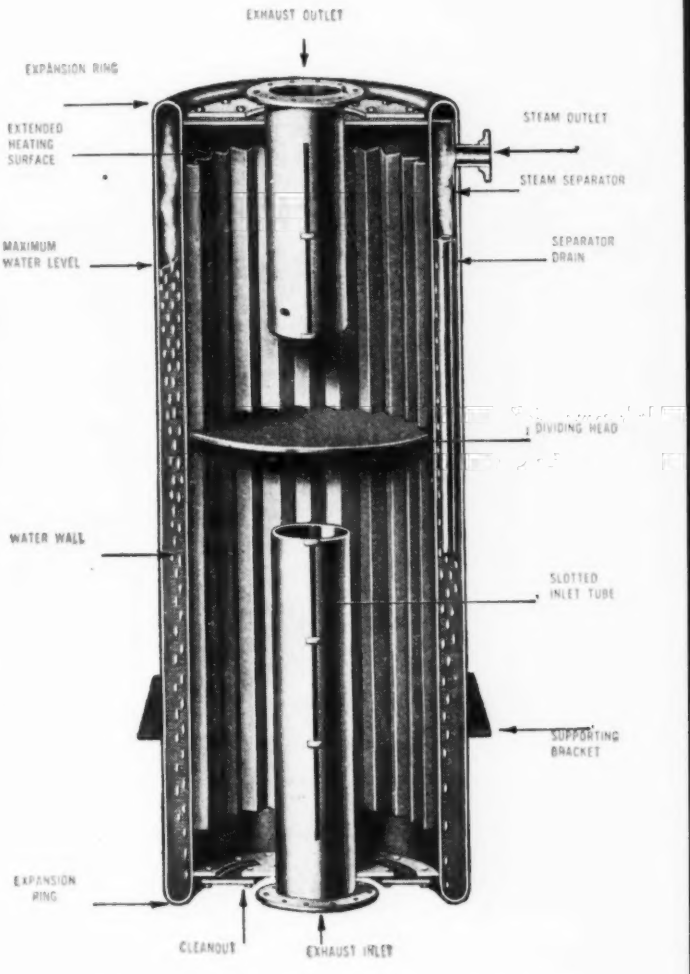
WITH MAXIM HEAT RECOVERY SILENCERS

Engine exhaust heat, all too often wasted, can be put to good and profitable use through Maxim Heat Recovery Silencers. With these specially constructed silencers extra steam or hot water for heating or processing operations is obtained *without extra fuel cost* as the heat source is simply engine exhaust heat. Thus in one unit effective exhaust silencing, spark arresting (where necessary) and heat recovery are combined for maximum operating efficiency. Such a saving, important to your balance sheet at any time, is doubly important where fuel supplies are difficult to obtain.

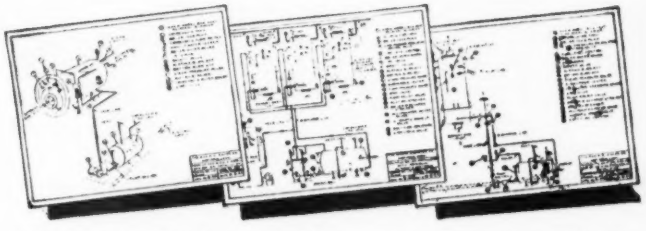
The power plant below located in northern Minnesota is heated entirely through the use of Maxim Heat Recovery Silencers.



For silencing, without the heat recovery feature, Maxim makes silencers for internal combustion engine exhaust or intake, steam engine exhaust, air compressor intake, vacuum pump discharge, blower intake and discharge, high velocity steam, air or gas discharge. Engine exhaust silencers available with or without spark arrestor. Bulletins on request.



PRACTICAL WORKING HOOK-UPS



The Maxim Engineering Department has prepared several drawings of typical Heat Recovery Silencer hook-ups. These are available with a detailed discussion of each hook-up. We will be glad to send them to you. Just ask for Dwgs. B-298, B-301, B-302 and B-303.

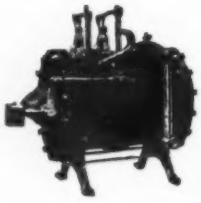
ARMY E NAVY

MAXIM

THE MAXIM SILENCER CO. • 92 HOMESTEAD AVE., HARTFORD, CONN.

STERLING

EXCLUSIVE—NO VENT
HEAT RETAINING
CONDENSATE RETURN SYSTEM



ALSO LIFTING — PUMPING
VACUUM CREATING AND
VACUUM DRAINING UNITS.

Use no electricity. No interference with operation on account of current failure. Noiseless Operation. Low maintenance cost.

Investigate Now

STERLING ENGINEERING & MFG. CORP.

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Your Up-to-date
HANDBOOK
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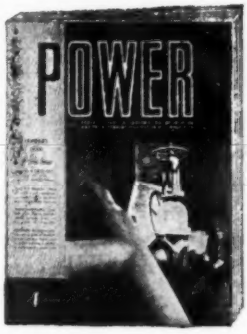
Latest
in Power-field
Practice



USE EVERY ISSUE

HOLTZER-CABOT

ELECTRONIC
INSULATION
RESISTANCE TESTER

SPOTS FAULTY INSULATION

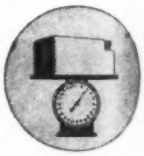
You can guard against possible insulation failures in electrical circuits and equipment by testing with the Holtzer-Cabot Insulation Resistance Tester. This portable self-contained unit spots faulty insulation before it can become dangerous. Here's how it works — connect terminal marked "L" to the electrical circuit and terminal "GRD" to a ground . . . rotate the handcrank of the generator at speed which lights up indicating buttons . . . reading on the scale indicates if insulation is faulty or not.

The Holtzer-Cabot Insulation Resistance Tester requires no batteries or external power supply. It is always ready to use in the plant, laboratory or field. The generator delivers 500 volts testing voltage regardless of cranking direction. Range is from 0 to 100 megohms. Protect your equipment from insulation failures by making periodic insulation tests with the Holtzer-Cabot Insulation Resistance Tester. Write for bulletin today.

Generates full voltage regardless of cranking direction.

Visual indication of correct testing voltage.

Easy to read scale.



Light Weight.

Portable.

HOLTZER-CABOT

Division of First Industrial Corporation

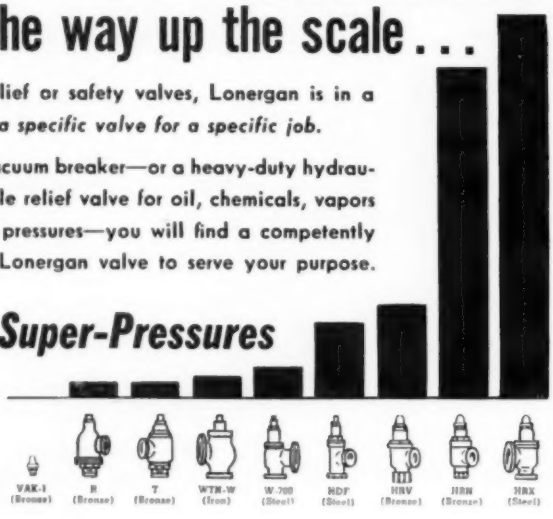
400 STUART STREET, BOSTON 17, MASS.

LONERGAN Relief Valves Provide Pressure Protection all the way up the scale . . .

Whatever you need in relief or safety valves, Lonergan is in a position to serve you with *a specific valve for a specific job.*

Whether it is a simple vacuum breaker—or a heavy-duty hydraulic relief valve—or a nozzle relief valve for oil, chemicals, vapors at high temperatures and pressures—you will find a competently engineered, quality-built Lonergan valve to serve your purpose.

From Vacuum to Super-Pressures . . . and for Every Type of Pressure System



A valve to fill your requirements may be illustrated here. The list, of course, is only partial. In the complete Lonergan Line, you have one of the most comprehensive selections of safety and relief valve designs. Let us cooperate with you by submitting recommendations. For information, write—

J. E. LONERGAN COMPANY, Race and 2nd Sts., Philadelphia 6, Pa.

Lonergan

Safety Valves • Relief Valves
Pressure Gauges • Specialties

SINCE 1872 — *Makers of Pressure-Safety Appliances for the Power, Mechanical, and Process Industries*

BULLDOG BUStribution DUCT

MANUFACTURERS, large and small, turn to BullDog for the real "know-how" in electrical distribution.

This is only natural, for BullDog pioneered plug-in power and lighting systems, and has introduced every important new improvement.

Three modern BullDog DUCT systems, the most widely used in industry, provide complete versatility and flexibility of power and light for every type of industrial application.

BUStribution DUCT (illustrated above) for plug-in power at any point—Industrial Trol-E-Duct for portable tools, cranes, hoists and other "moving loads"—Universal Trol-E-Duct for completely flexible lighting.

For quality as well as "know-how," BullDog has enjoyed a reputation of leadership for nearly half a century.

Write for our illustrated bulletins for detailed information. Or, better yet, our expert staff of conveniently located field engineers will welcome an opportunity to work with you on your electrical distribution problems.

Buy More War Bonds

BULLDOG

ELECTRIC PRODUCTS COMPANY

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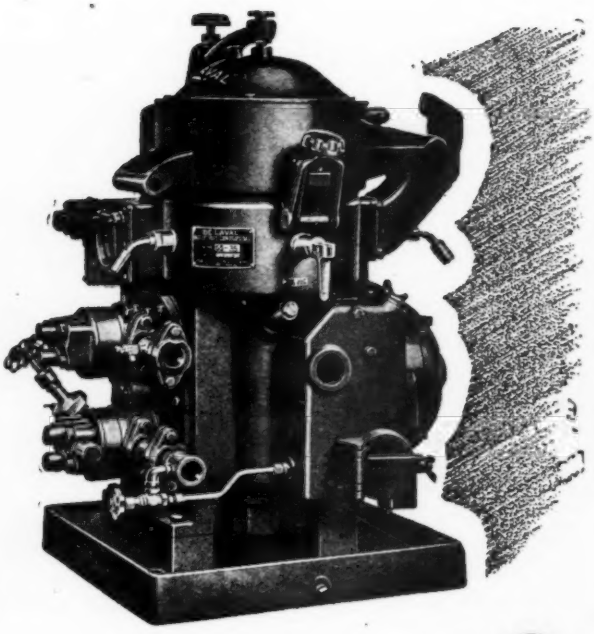
BOX 177, R. PK. ANNEX, DETROIT 32, MICHIGAN
In Canada: BullDog Electric Products, Ltd., Toronto
Field Engineering Offices in All Principal Cities

Also Manufacturers of
SaftoFuse Panelboards — Switchboards — Circuit Master Breakers—BUStribution Duct, for "plug-in" power—Universal Trol-E-Duct, for flexible lighting — Industrial Trol-E-Duct, for movable "loads."

How much DOES A DE LAVAL PURIFIER COST?



THE cost of a De Laval centrifugal Oil Purifier of any given size is invariably only a fraction of the cost of the prime mover it protects. The comparatively modest investment represented by a De Laval Oil Purifier is far outweighed by the cost of even one serious shutdown . . . a De Laval is, in truth, inexpensive insurance.

A De Laval Purifier instantaneously removes from lubricating oil all water, dirt or sludge by means of centrifugal force, keeping the oil clean and making it safe to use over and over again. Many generating stations now use the complete De Laval-Funk Process, which minimizes the formation of sludge within the lubricating system while it also continuously purifies the oil by means of the De Laval centrifugal machine—the ultimate in turbine oil protection.

Whether a particular installation calls for a single De Laval Oil Purifier or a complete De Laval-Funk Process, there is a wide range of capacities available, enabling every operator to secure the correct unit for his purpose.

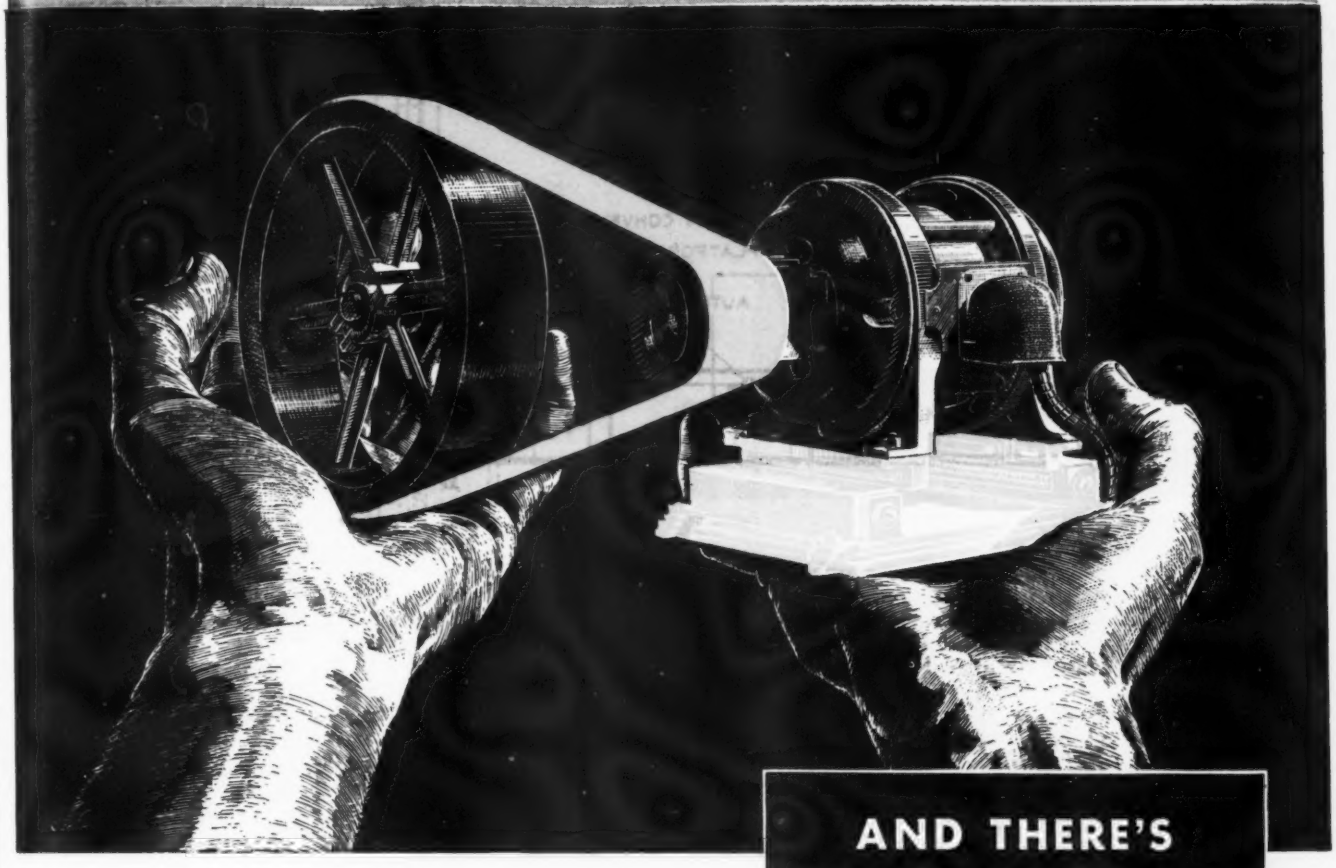
• Write for complete information.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 19
THE DE LAVAL COMPANY, Limited
MONTREAL PETERBOROUGH WINNIPEG VANCOUVER

DE LAVAL OIL PURIFIERS

FOR MORE DEPENDABLE POWER PRODUCTION

HERE'S THE ONLY BELT DRIVE THAT DOESN'T DEPEND ON TENSION!



AND THERE'S ONLY ONE BELT FOR THAT DRIVE

The high but often unsuspected costs of over-tensioned or under-tensioned belts *can* be eliminated. With the Flat Leather Automatic Tension drive, there is no need to *overstress* tension to make sure of handling peak loads . . . no need for frequent maintenance to correct slippage due to *under-stressed* tension.

It is the action of the pivoted base that keeps the drive delivering — not the initial tension on the belt. Tension is always right, automatically. When the load is heavy, the pivoted base *tightens* the belt. When the load is light, the pivoted base *relaxes* the belt. Belt and bearings work hard *only* when the load is heavy.

There is no pulley realignment problem. If the base ever has to be adjusted, it can be done while the motor is running, and alignment is not critical.

Save maintenance . . . on belts, on bearings. Let the pivoted base do your worrying for you. Install the Flat Leather Automatic Tension drive—with "Research" Leather Belting.

Graton & Knight's "Research" Belt has the ideal qualities for service with pivoted bases:

- Highest coefficient of friction and flexibility so that it hugs the small pulley with minimum slip, thus reducing tension needed.
- Least stretch, guaranteeing long, uninterrupted performance.

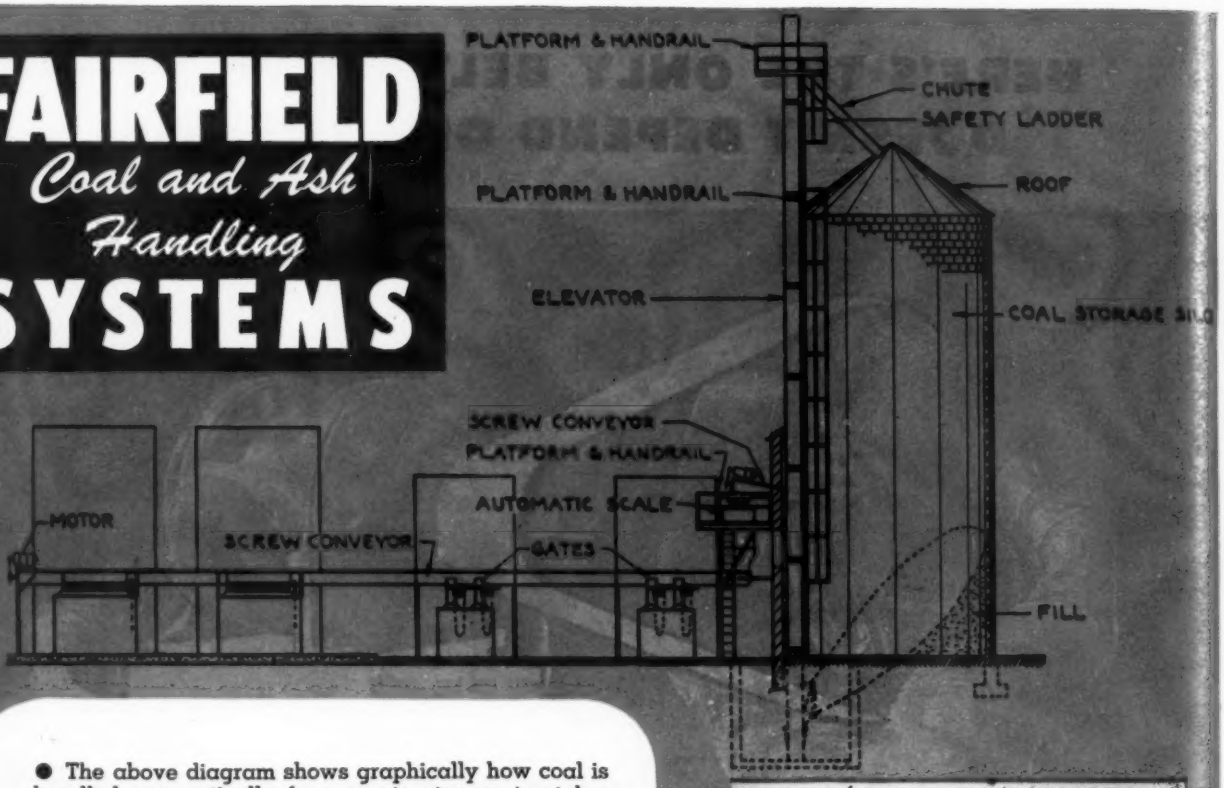
A "Research" Belt on Flat Leather Automatic Tension drive will outlast a rubber V-belt on a corresponding drive by 2 to 1! Write Graton & Knight Company, 333 Franklin St., Worcester 4, Mass., for new, free Belting Manual.

GRATON AND KNIGHT

Research Leather Belting

from Graton & Knight's complete line . . . manufactured under one control from green hide to finished product. Branches and distributors everywhere. Look under "Graton & Knight" in "Belting" section of Classified Telephone Directory or THOMAS' REGISTER.

FAIRFIELD
Coal and Ash Handling SYSTEMS



● The above diagram shows graphically how coal is handled automatically from car to storage to stoker or pulverizer by the Fairfield Silo System.

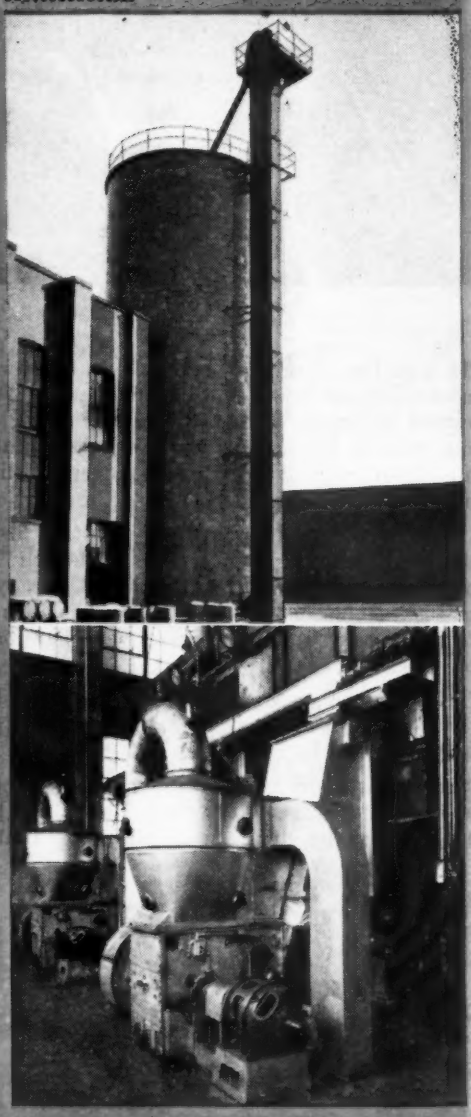
The Fairfield Silo System has several advantages which appeal to both power plant engineers and operating executives. The Silo is built outside the power plant—eliminating dust and dirt from the boiler room . . . it is built of vitrified salt glazed tile—does not absorb moisture and the air spaces provide effective insulation in freezing temperatures . . . the system provides a choice of methods for handling coal from storage to stoker or pulverizer—the two most common are the screw conveyor as illustrated above, or a weigh larry.

The silos take up very little space (12 to 24 feet diameter) and are particularly adapted to boiler plants requiring 200 to 1000 tons of covered coal storage. For plants of these sizes the cost per ton for silo storage is somewhat less than for any other type of installation where coal is stored in an enclosure.

The Fairfield system often includes complete ash handling and storage facilities which are equally efficient.

Each installation is designed—built—and erected by Fairfield to fit the particular plant. You have but one responsibility for the entire installation.

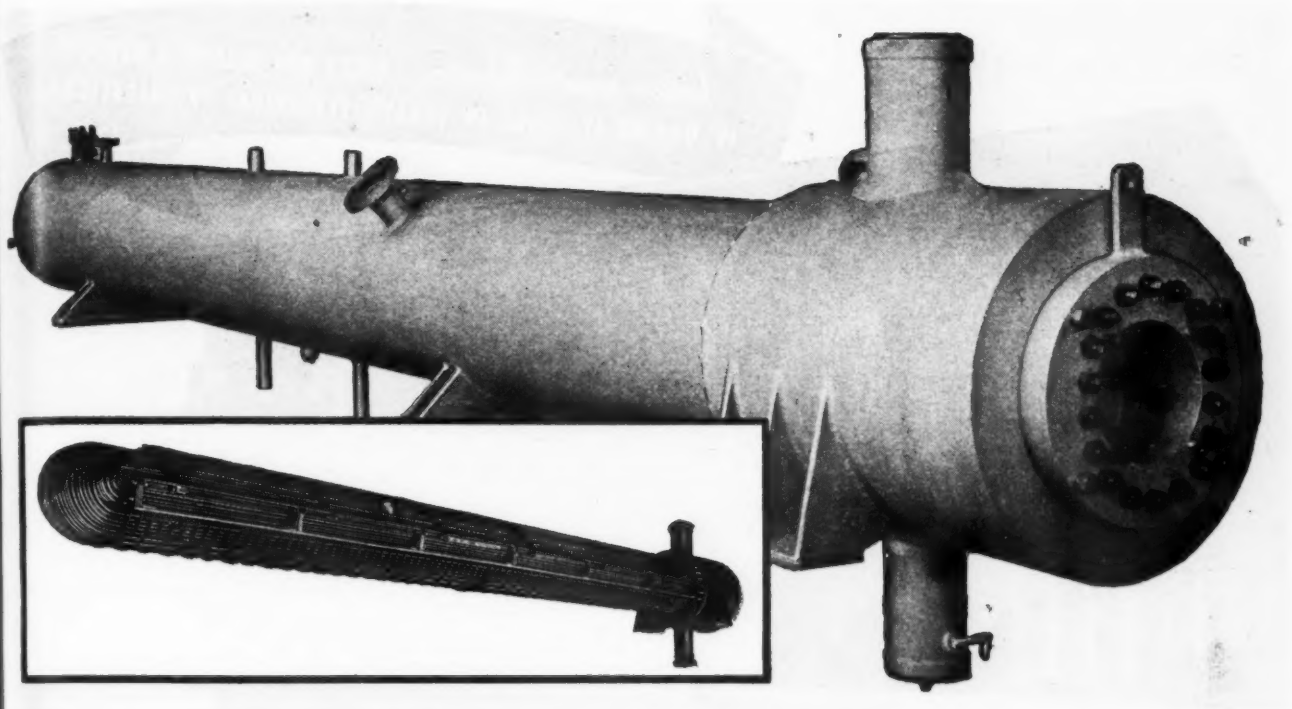
Consult a Fairfield Engineer on your coal and ash handling problems whether they involve conversion from your present system—a new plant—or additions to your present plant. Catalog upon request.



THE FAIRFIELD ENGINEERING CO.

Builders of Coal and Ash Handling Equipment

320 CHICAGO AVENUE • • • MARION, OHIO



This G-R STAGE HEATER combines

SIMPLICITY... because the U-tube construction and tube sheet integral with water head requires a minimum of high pressure joints.

RUGGEDNESS... because of sturdy construction; including ample support of tubes, and prevention of vibration by minimum clearance at tube support plates.

ACCESSIBILITY... because the only high-pressure joint is a single manhole cover.

The design and construction of this unit is based on 76 years of experience in building heat transfer apparatus.

Write for Bulletin

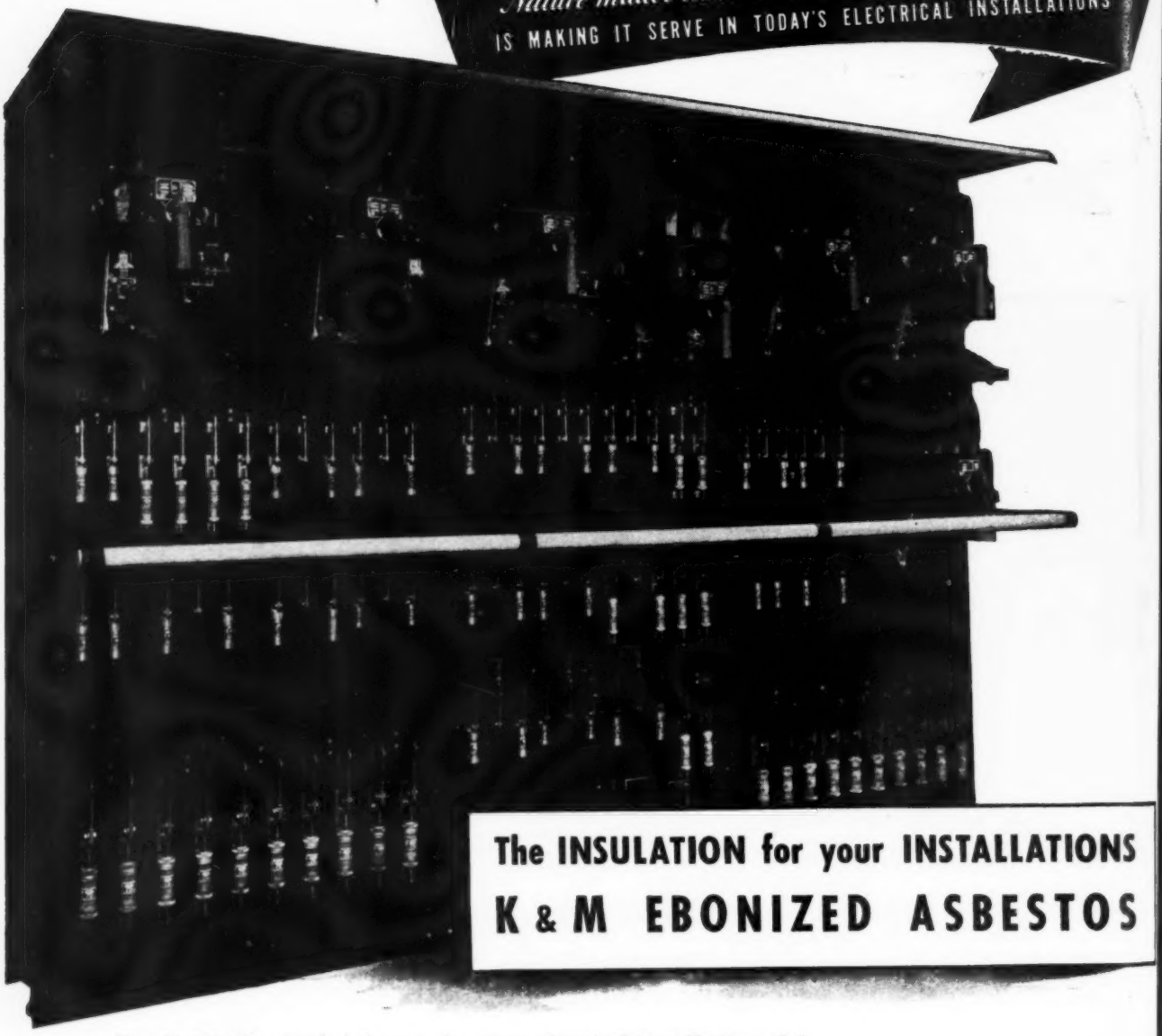
The Griscom-Russell Co.
285 Madison Avenue
New York 17, N. Y.

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

Courtesy I.T.E. Circuit Breaker Co.

Nature made Asbestos . . . HERE'S HOW KEASBEY & MATTISON IS MAKING IT SERVE IN TODAY'S ELECTRICAL INSTALLATIONS



The INSULATION for your INSTALLATIONS

K & M EBONIZED ASBESTOS

● Use K&M Ebonized Asbestos for your electrical installations. It's made especially for modern electrical usage . . . switchboards, bus bar runs, testing tables, panel boards. It's a tough insulating material, made of a perfectly proportioned combination of asbestos fibre, binding cement and insulating compound, molded under intense pressure into strong monolithic sheets.

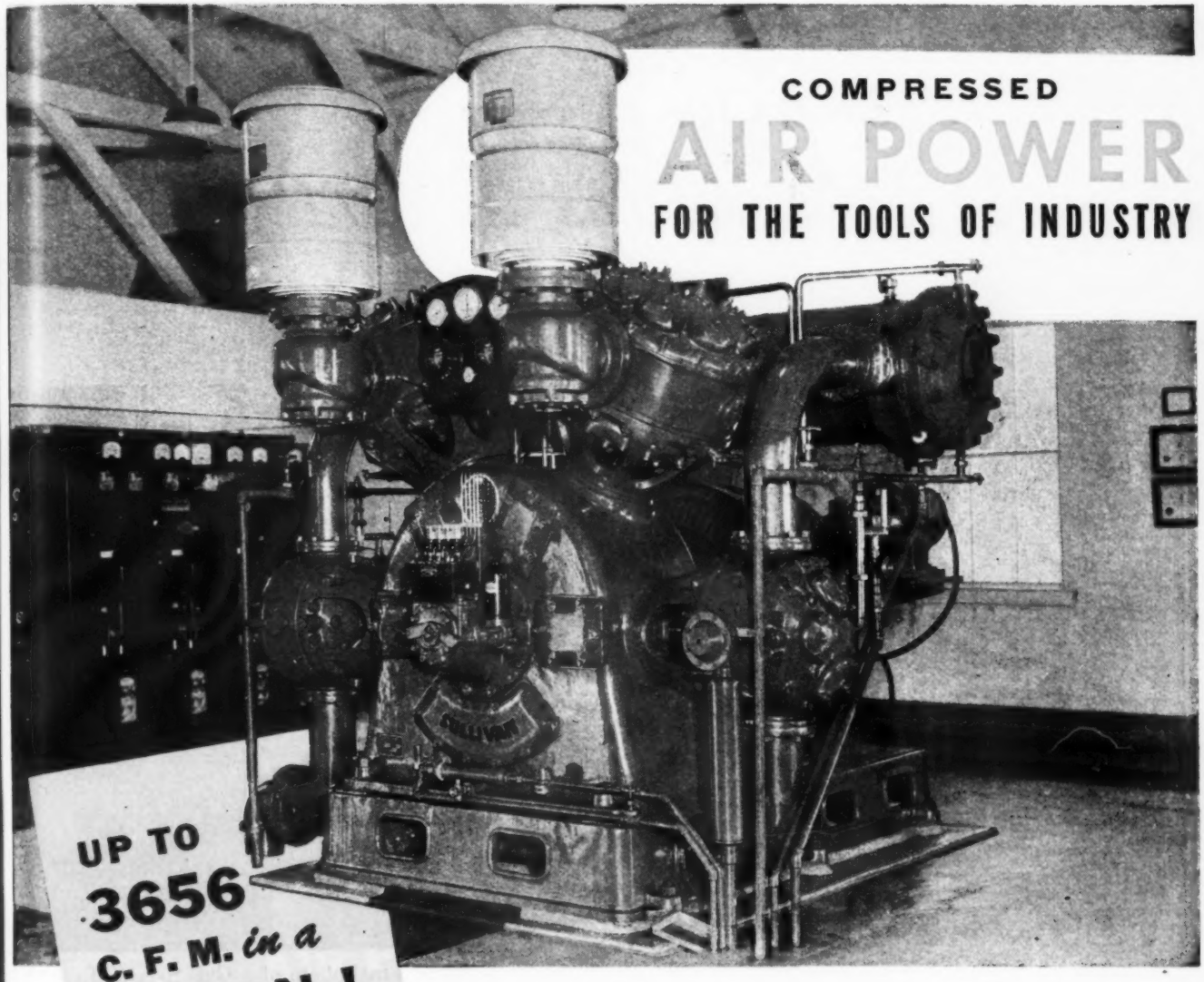
Here are the special features of K&M Ebonized Asbestos . . .

Exceptionally high dielectric strength.
Uniform density throughout.
Withstands severe shock, vibration and wide temperature variation.
Resists oil and water action.
Does not shrink, crack or bulge.

K&M Ebonized Asbestos is available for prompt delivery. Comes in thicknesses from ⅛" to 4", standard or special "panel" finish. Specially developed to meet technical requirements of the Underwriters Laboratories, Inc., when built into an assembled unit.

ARMY E NAVY
K&M
best in asbestos

KEASBEY & MATTISON COMPANY • AMBLER • PENNSYLVANIA

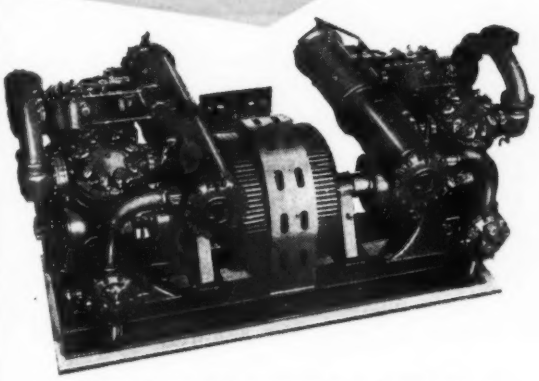


COMPRESSED

AIR POWER

FOR THE TOOLS OF INDUSTRY

UP TO 3656 C. F. M. *in a* TWIN!



Sullivan Series 100 compressors are available in two and four cylinder models and in single and twin units. Capacities from 378 to 3656 c.f.m.

with a SULLIVAN

HEAVY-DUTY WN-114 COMPRESSOR

Install it, start it,—then forget it! That's what you can do with Sullivan compressed-air power units, because they are built to give constant, dependable service 24 hours a day, year in and year out.

Sullivan Series 100 air compressors are two-stage, double-acting, heavy duty, continuous service compressors, much smaller than old style compressors of the same capacity and yet have operating economies exceeding those of the older, bulky units of the same capacity. *Sullivan Machinery Company, Michigan City, Indiana. IN CANADA: Canadian Sullivan Machinery Co., Ltd., Dundas, Ontario.*

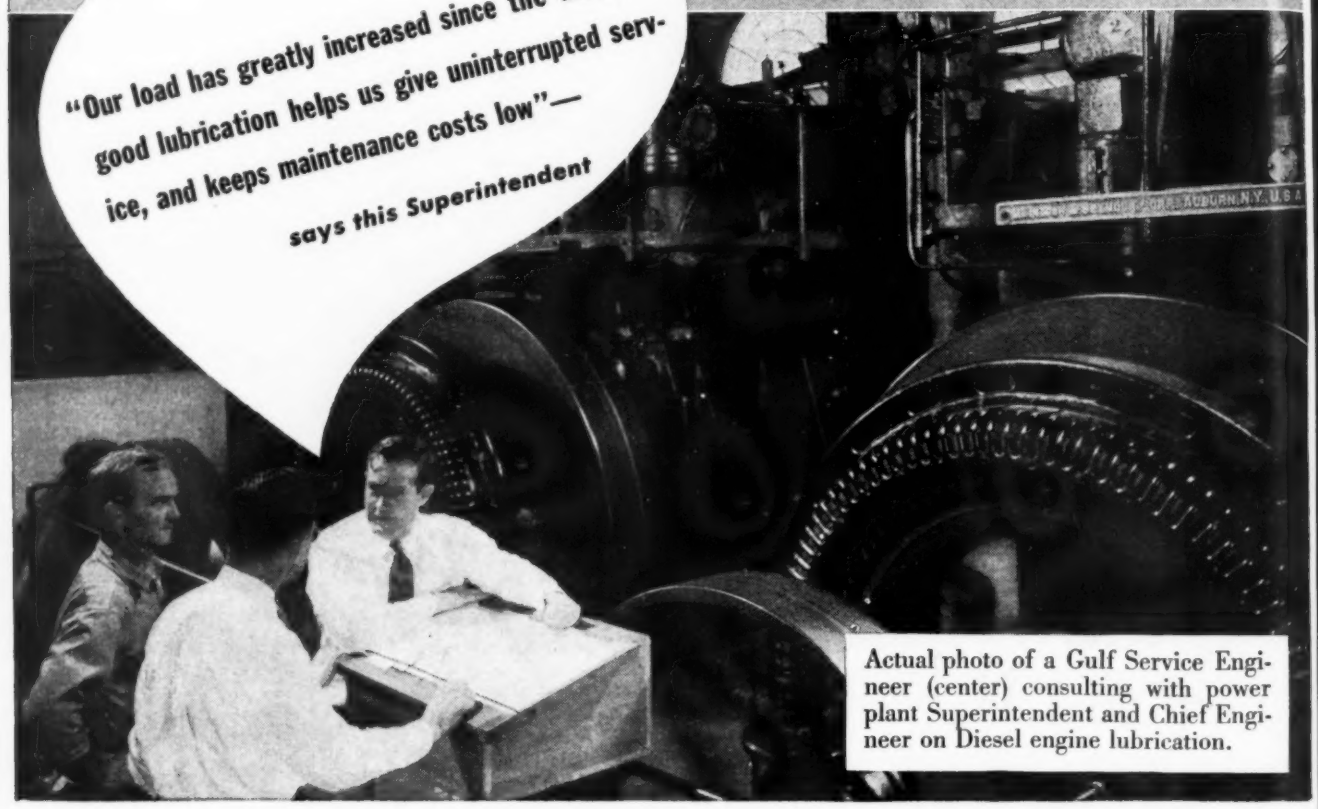
SULLIVAN *... the world's finest air compressor*

from 1/4 to 3,000 h. p.

OFFICES—Seattle • Spokane • Boston • New York • Chicago • Portland • Pittsburgh • Philadelphia • St. Louis • Detroit • San Francisco • Birmingham • Knoxville • Huntington • Los Angeles • Duluth • El Paso • Butte • Salt Lake City • Scranton • Denver • Dallas.

PRODUCTS—Stationary and Portable Air Compressors • Pneumatic Casting Grips • Foundation Breakers • Portable Hoists • Rock Drills.

No repairs for 16 years with GULF PARVIS OIL !


"Our load has greatly increased since the war, but good lubrication helps us give uninterrupted service, and keeps maintenance costs low"—
says this Superintendent

Actual photo of a Gulf Service Engineer (center) consulting with power plant Superintendent and Chief Engineer on Diesel engine lubrication.

NO REPAIRS NECESSARY for over 16 years, and operating efficiently today under a greatly increased load—that's the hard-to-beat performance record of our two 600 h.p. Diesels with Gulf Parvis Oil," says this Superintendent. "Proper lubrication pays us big dividends—uninterrupted service and negligible maintenance costs."

Additional proof that Gulf Parvis Oil provides better lubrication for large stationary and marine Diesels! And better lubrication means lower maintenance costs, improved performance.

If you are not one of the hundreds of enthusiastic users of Gulf Parvis Oil, it will pay you to investigate — call in a Gulf Lubrication Service Engineer and ask him to recommend the proper grade to fit your particular requirements.

Gulf Parvis Oil is available to you through 1200 warehouses located in 30 states from Maine to New Mexico. Write, wire, or phone your nearest Gulf office today.

GULF INDUSTRIAL LUBRICATION

GULF OIL CORPORATION • GULF REFINING COMPANY

Division Sales Offices:

Boston · New York · Philadelphia · Pittsburgh · Atlanta
New Orleans · Houston · Louisville · Toledo

if so, here's help!

SHOW HOW

There you have it, the answer is COMPRESSED AIR. Every plant foreman should have a copy of this booklet — it is a clearing house of ideas for production men.

Write or phone the company or any of its branches today for your copy; it is yours for the asking.

Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y.

Please Send Us a Copy of Bulletin
"A LITTLE AIR POWER WILL DO MANY A BIG JOB"

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Branches or Distributors in other Principal cities the world over.

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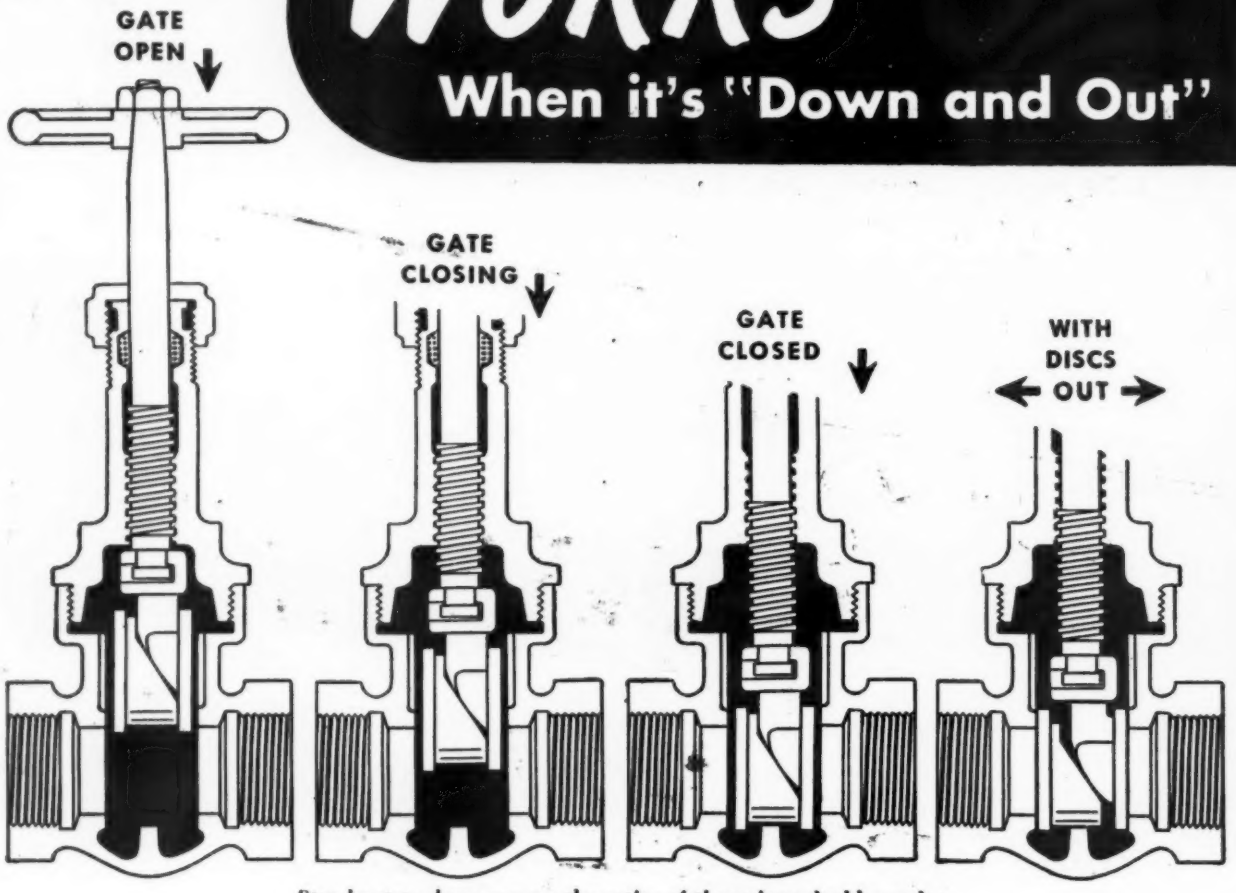
Boston	Chicago	Dallas	Duluth	Houston	Los Angeles	New Orleans	Picher	Salt Lake City	Seattle	Washington

WORKS

When it's "Down and Out"



Step by step above, you see the action of the unique double-wedge and double-disc gate assembly as a Darling valve is closed.

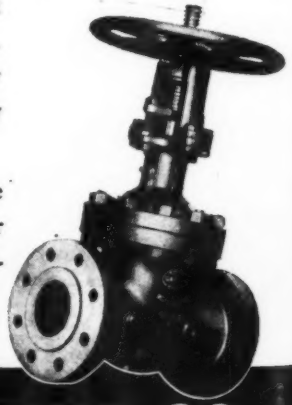
THERE'S nothing hard about making a valve. The bung in a barrel, the spigot in a wine keg, the baffle in a flue—they are all valves of a sort. The trick is to make a good one.

The Darling fully revolving double disc, parallel seat gate valve embodies a unique design that insures tight closing, easy operation and long life.

The Darling gate consists of only four parts, two discs, two wedges. In closing the Darling valve, the gate is lowered into the body until the discs are opposite the seats. There is no forcing to wear or gall seats and discs.

When the lower wedge contacts the bridge in the bottom of the body, the wedges begin to spread, and the discs are forced out against the valve seats. There is no tearing of metal against metal; discs simply go "down and out". They fit tightly. They wear evenly. They last for years. The valve is always easy to operate.

We'll be glad to give you complete information about Darling valves, or send you our 300-page, illustrated Catalog No. 17.



TRADE DARLING MARK

VALVE & MANUFACTURING CO.

WILLIAMSPORT, PA.

OPERATIONS SIMPLIFIED IN TWO-HIGH SKIN PASS MILL

System operates from the plant A-c circuit, through variable-voltage power from a Reliance 5-unit M-G set with booster-generators.

Constantly controlled tension under all conditions, vital to satisfactory results in handling coiled steel, is obtained automatically in this mill by means of Reliance Motor-drive with all-electric, centralized control.

The uncoiler is kept under proper tension during all speed changes, and during the progressing reduction in coil diameter. At the same time, delivery tension is maintained as the coil increases on the recoiler.

In ease and simplicity of operation, improved quality as well as quantity of production, this application of Reliance Motor-drive has more than paid its way in comparison to former methods. If you would like to investigate the many possibilities of all-electric control, why not talk with a Reliance application engineer?

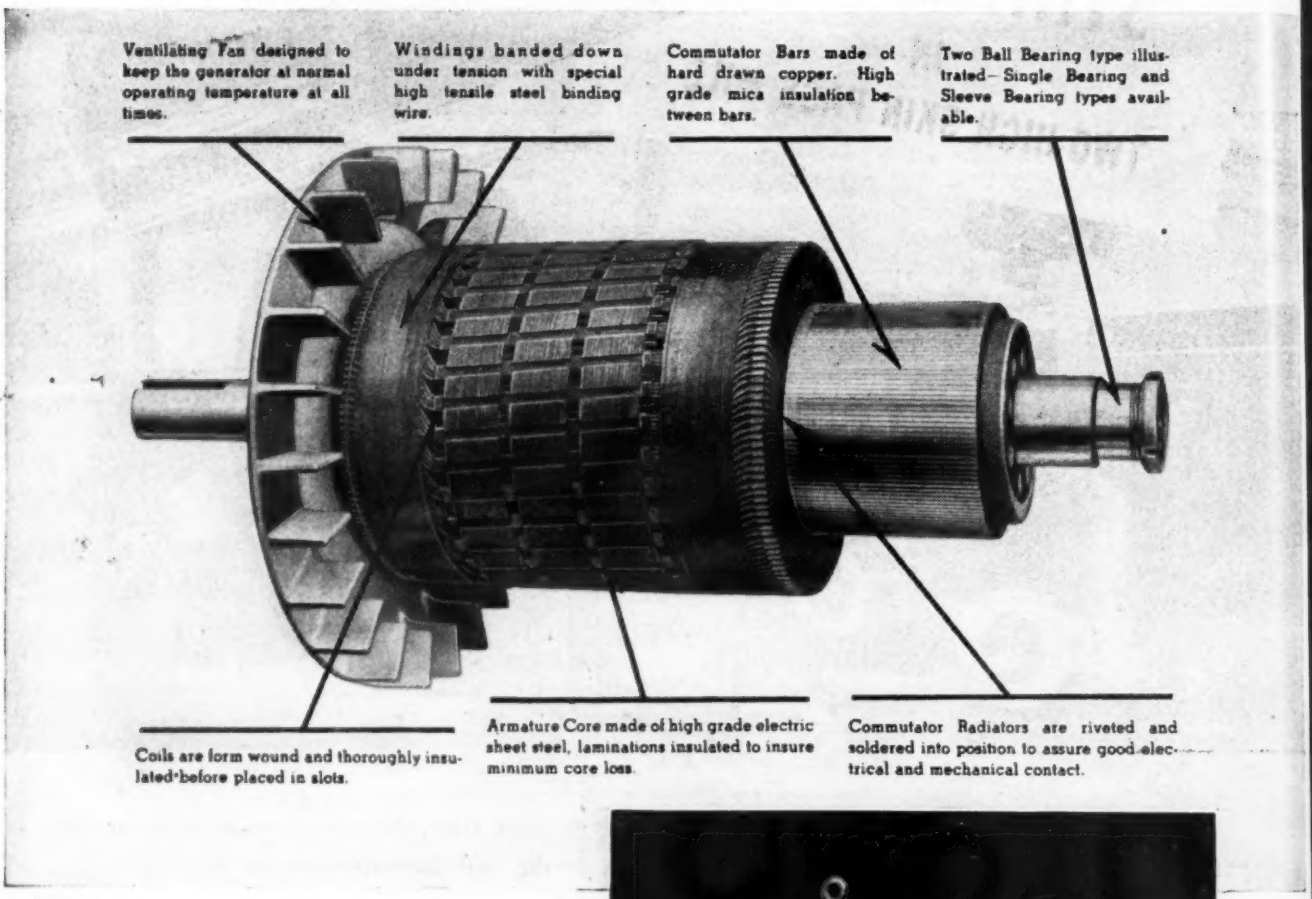
RELIANCE ELECTRIC & ENGINEERING COMPANY
1068 Ivanhoe Road • Cleveland 10, Ohio

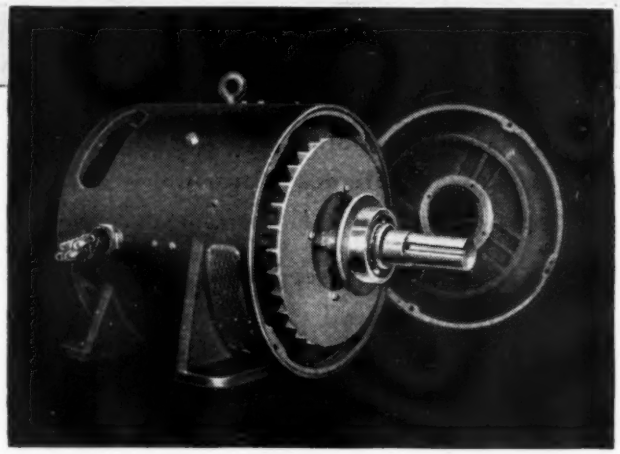
Birmingham • Boston • Buffalo • Chicago • Cincinnati • Detroit • Greenville (S. C.) • Houston • Kalamazoo • Los Angeles • Minneapolis
New York • Philadelphia • Pittsburgh • Portland (Ore.) • St. Louis • San Francisco • Syracuse • Washington, D. C. • and other principal cities

RELIANCE A-C D-C MOTORS

"Motor-Drive is More Than Power"

BURKE *54 years of* D. C. EXPERIENCE


Ventilating Fan designed to keep the generator at normal operating temperature at all times.
Windings banded down under tension with special high tensile steel binding wire.
Commutator Bars made of hard drawn copper. High grade mica insulation between bars.
Two Ball Bearing type illustrated—Single Bearing and Sleeve Bearing types available.
Coils are form wound and thoroughly insulated before placed in slots.
Armature Core made of high grade electric sheet steel, laminations insulated to insure minimum core loss.
Commutator Radiators are riveted and soldered into position to assure good electrical and mechanical contact.



BURKE 2-Bearing Type D. C. Generators illustrated, are built for belt or direct drive use from 1750 to 450 r. p. m. and for any voltages from 32 to 250. This general purpose generator is widely used by the Navy and Merchant Marine and throughout industry.

A few features are described above and bulletin 600 covers all types of Burke D. C. Generators. Write for copy.

BURKE ELECTRIC COMPANY • ERIE, PA.

ARMY E NAVY

★ SYNCHRONOUS MOTORS AND GENERATORS
★ INDUCTION MOTORS
★ D. C. MOTORS
★ D. C. GENERATORS
★ M-G SETS
★ HIGH SPEED A. C. GENERATORS

MOTORS 1 TO 1500 H. P. • GENERATORS 1 TO 1000 K. W.

BURKE A.C. & D.C. Motors & Generators

BURKE ELECTRIC COMPANY, ERIE, PENNSYLVANIA • *Since 1891*

Why is FALK a good name in industry?

A business institution acquires a fine reputation, not because of its size, not because of the dividends it pays, not because of the patents it holds; but because of the acceptance of its products and methods of doing business by prospects, by customers, and by its employes.

For over fifty years prospective customers for Falk products have been gracious in their acceptance of Falk representatives.

Actual customers have purchased and repurchased Falk products year after year.

Falk employes are proud to be associated with the Falk Corporation, and verify their pride by many years of service.

This is evidenced by the Navy's acceptance of Falk products since before World War I; by the attitude of the Falk management toward Falk employes during the lean years of the economic cycle; by the honors bestowed upon Falk officials; by recognition of the high standards of its employe relations accorded by a national magazine; and by interplant and office activities of the employes themselves.

It has long been an axiom of the Falk management that "to build a better product, first improve the man." Falk quality is due in no small measure to the thoroughness of Falk apprenticeship courses.

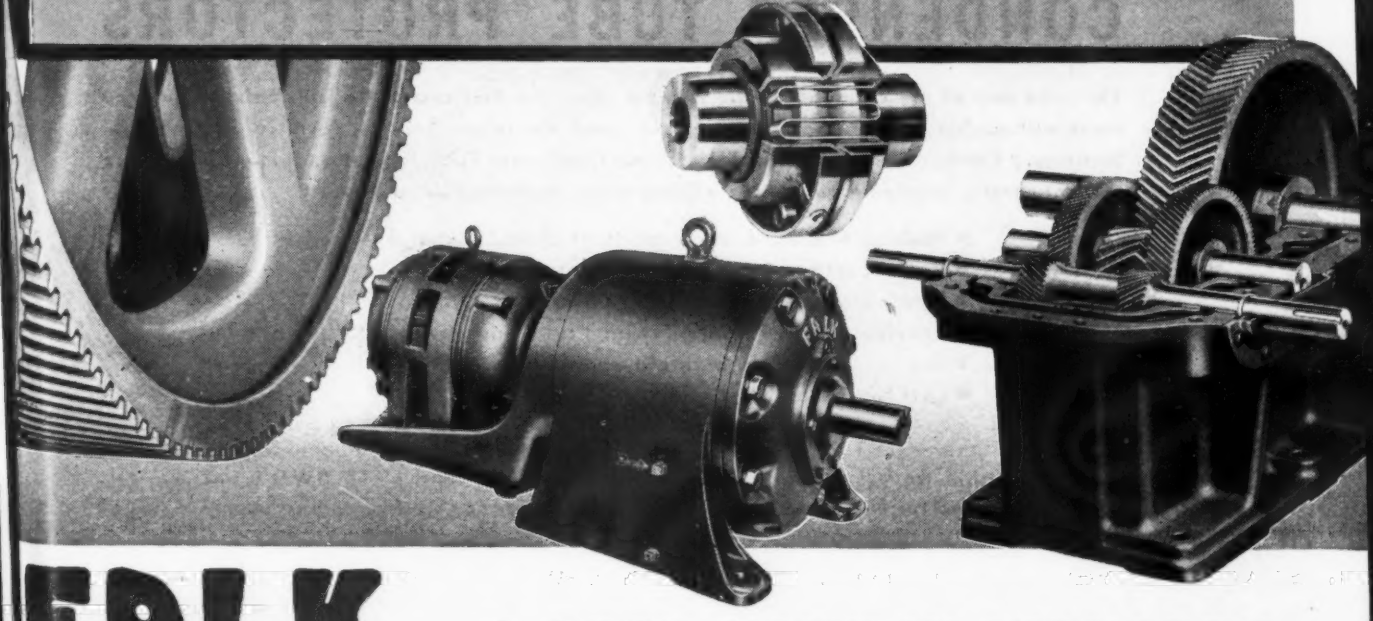
The same thoroughness employed in molding men is employed in molding Falk material. Falk casts its own steel in its own foundry to its own specifications.

To secure the watch-like precision so characteristic of all that Falk produces, it has always been the Falk policy to design its own machinery.

Because Falk has always known its men, its material, and its tools, it logically follows that Falk engineering has always been better than it could have been, had this engineering been done with unknown components.

All of this is just plain good business. No reputation can ever be acquired, much less maintained, unless it is based on plain good business. For plain good business is business that is good first for the customer, then for the employe, then for the corporation—and only then for the management.

This is why Falk is "a good name in industry".

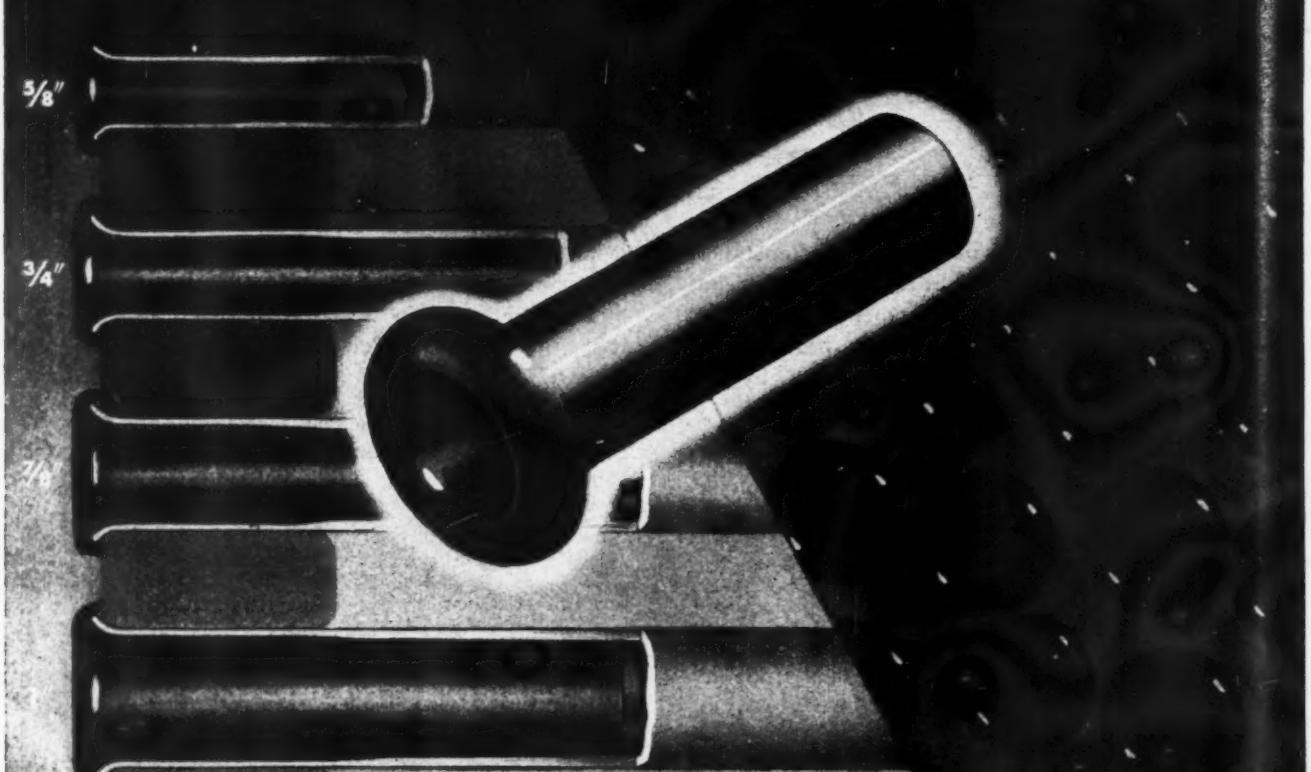


FALK...A GOOD NAME IN INDUSTRY

THE FALK CORPORATION, MILWAUKEE 8 WISCONSIN

District Offices, Representatives, or Distributors in principal cities

Save CRITICAL TUBE METAL



Install JOHN CRANE
CONDENSER TUBE PROTECTORS

The inlet end of the condenser tube is most often the first section to fail. This is the area most vulnerable to air impingement and sand abrasion. Service Tests in Marine and Stationary Condensers prove that John Crane Condenser Tube Protectors *armor the entrance section; greatly lengthen tube life.* Note these other important advantages:

- **Molded of a hard, wear-resistant plastic material**
- **Resist contaminated salt or fresh water**
- **Unaffected by temperatures to 275° F.**
- **Provide a belled mouth for inlet tube ends; reduce turbulence**
- **Easily installed on both old and new tubes**
- **Last for life of tubes**

John Crane Condenser Tube Protectors are inexpensive to install; and require no special tools. Available for 5/8" and 3/4" 16-BWG, or 5/8", 3/4", 7/8" and 1" 18-BWG tubes. For full information send for *illustrated* bulletin, or consult our branch office *nearest you.*

CRANE PACKING COMPANY — 1811 CUYLER AVE. • CHICAGO 13, ILL.

BALTIMORE, BOSTON, BUFFALO, CLEVELAND, DALLAS, DETROIT, HOUSTON, LOS ANGELES, NEW ORLEANS, NEW YORK, PHILADELPHIA, PITTSBURGH, SAN FRANCISCO, ST. LOUIS, TULSA

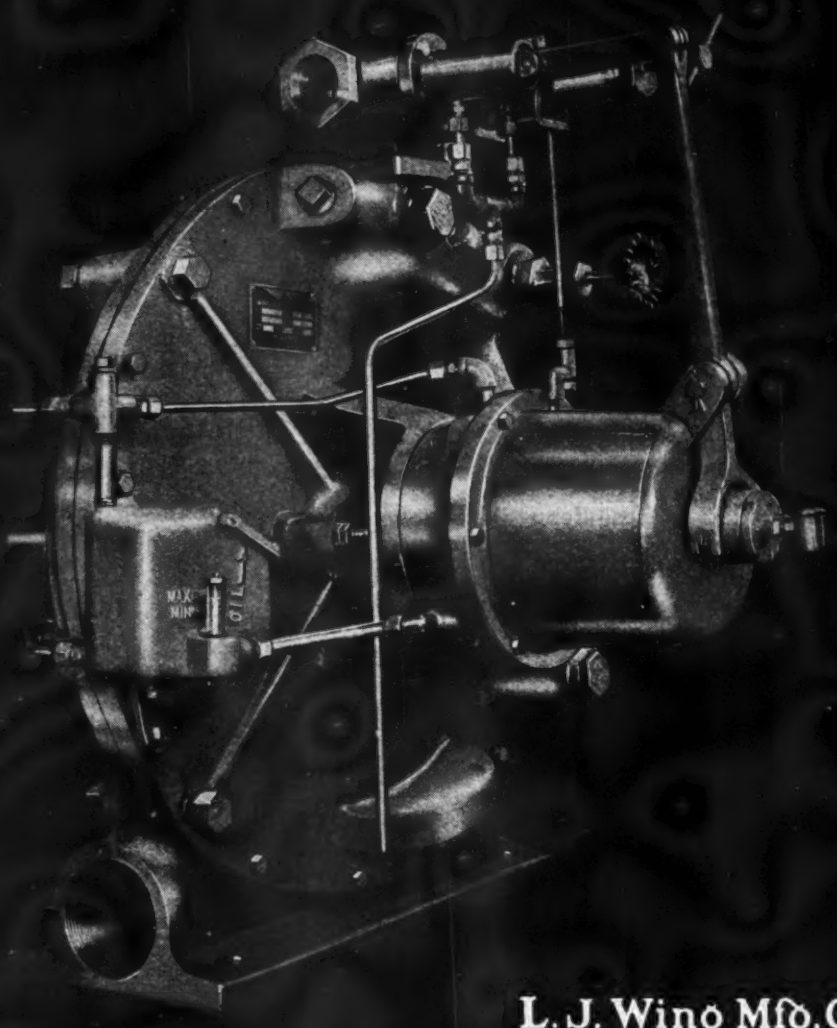
CRANE PACKING CO., LTD., Hamilton, Ontario, Canada. Branches: Montreal, Toronto, Vancouver

OPERATING RANGES

	Standard	High Pressure
Maximum B. H. P.	100	150
Max. Steam Temp.	525°F.	750°F.
Max. Pressure	275 lbs.	600 lbs.
Back Pressure up to	50 lbs.	50 lbs.
Speeds up to	4000 RPM	4000 RPM

USES

PRIME MOVERS FOR MIXERS, MARINE GEAR, PUMPS, FANS, STOKERS, WINCHES, GENERATORS, COMPRESSORS



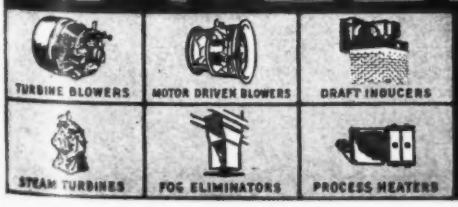
Write For Bulletin SW-1

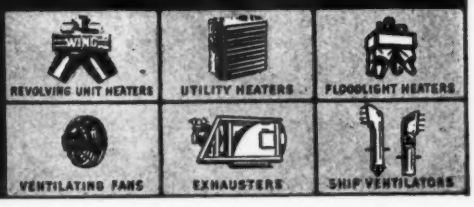
L. J. Wing Mfg. Co.

154 W. 14th St., New York 11, N. Y.

Factories, Newark, N. J. and Montreal, Canada

Wing TURBINES

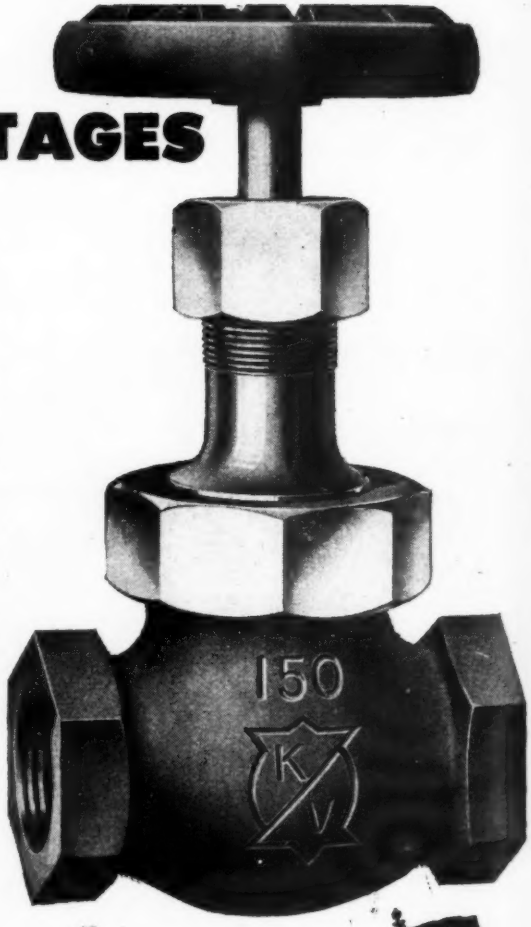




"Trifles make perfection but perfection is no trifle"

One of a series of advertisements explaining how Kennedy gives careful attention to the details of valve design, construction and workmanship that provide maximum effectiveness, convenience, and length of service.

You wouldn't think a DISC HOLDER could have so many ADVANTAGES



The disc holders in these Kennedy 150 lb. renewable composition disc bronze globe and angle valves are literally crowded with special features and advantages.

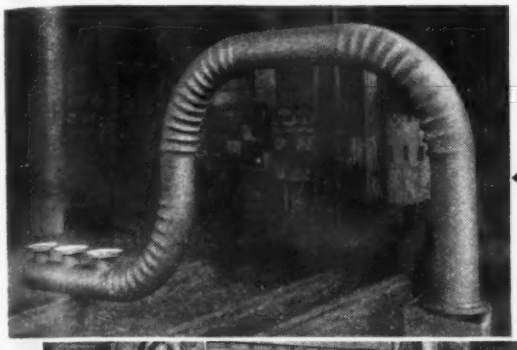
To begin with, four guide prongs are provided to guide the disc holder accurately in the body and prevent tipping or binding. A smooth milled bearing surface in the stem-head recess permits the disc holder to swivel freely on the slightly rounded smooth bottom surface of the stem head so that the disc can accommodate itself to the seat. The outer edge of the holder overhangs the seat so as to permit considerable wear of the disc before renewal becomes necessary.

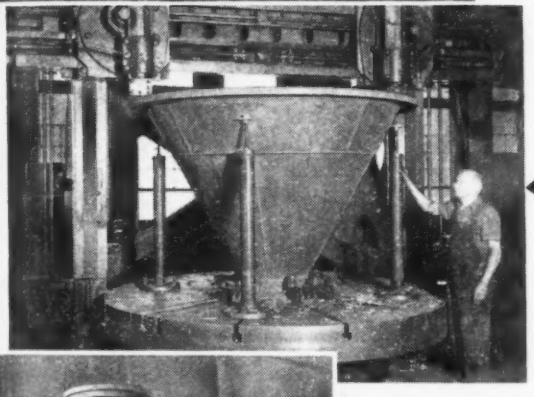
Then, additional features assist convenience of disc renewal. The holder locks itself positively in place on the stem at a definite position, wide open, so that it cannot fall off when the valve is taken apart. This arrangement protects the disc from damage and prevents the holder from interfering with reassembly of the valve. Once the stem and disc holder assembly is removed from the valve, a mere half-turn of the stem releases the holder and permits it to drop off.

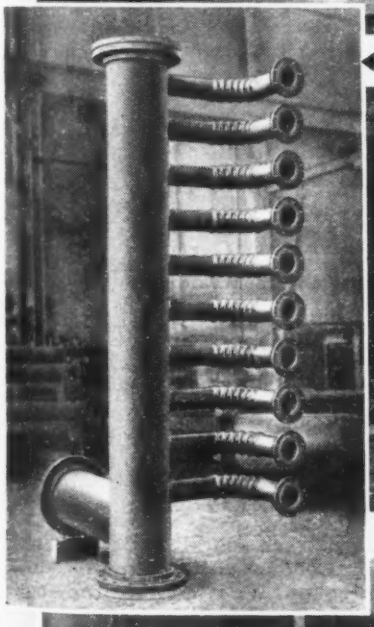
THE KENNEDY VALVE MFG. CO.
ELMIRA • NEW YORK

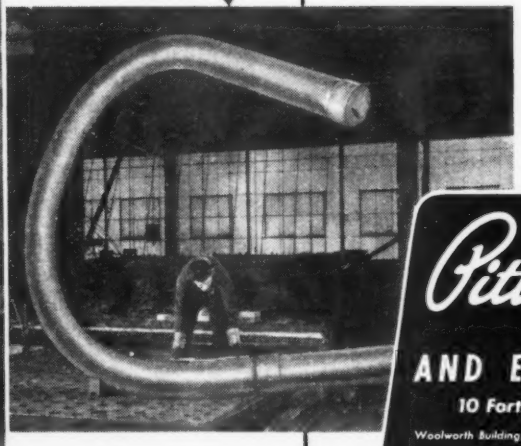
KENNEDY *valves... pipe fittings... fire hydrants*

Modern Shop Fabrication









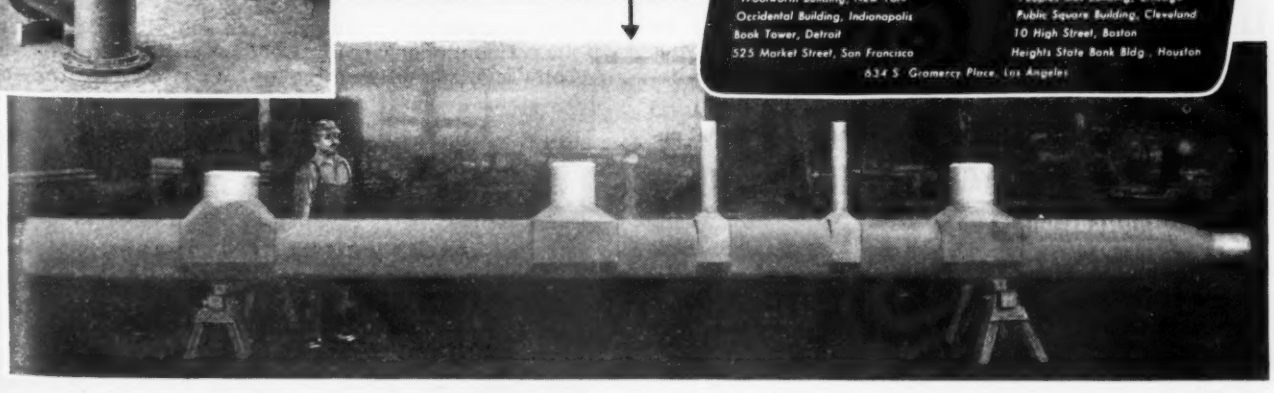
combines
SPEED with ACCURACY
ECONOMY with SAFETY

For over forty years Pittsburgh Piping & Equipment Company has specialized in the fabrication of piping of every type and material. This long experience in shop fabrication and field installation, coupled with modern facilities and equipment, much of which we designed and developed, puts us in position to fill all of your piping requirements, whether it involves a single unit or a complete piping system. Illustrations depict a few of various units and sub-assemblies of piping, involving operations which cannot be performed except in a properly equipped plant with adequate facilities and trained personnel.

Sub-assemblies are prefabricated into units as large as shipping facilities and installation space will permit, with all difficult operations performed. These sub-assemblies have been heat treated, stress relieved, carefully checked for dimensional alignment, pressure tested, cleaned and inspected, and are ready to slip into place with a minimum of time and labor. Shop fabrication combines speed with accuracy . . . economy with safety. It assures you of receiving the best in piping service.

Our engineers will gladly work with you on any piping problem. Contact our nearest representative or write us direct. There is no obligation.

Buy EXTRA
War Bonds



Pittsburgh Piping
AND EQUIPMENT COMPANY
10 Forty-Third Street—Pittsburgh, Penna.

Woolworth Building, New York
Occidental Building, Indianapolis
Book Tower, Detroit
525 Market Street, San Francisco
Peoples Gas Building, Chicago
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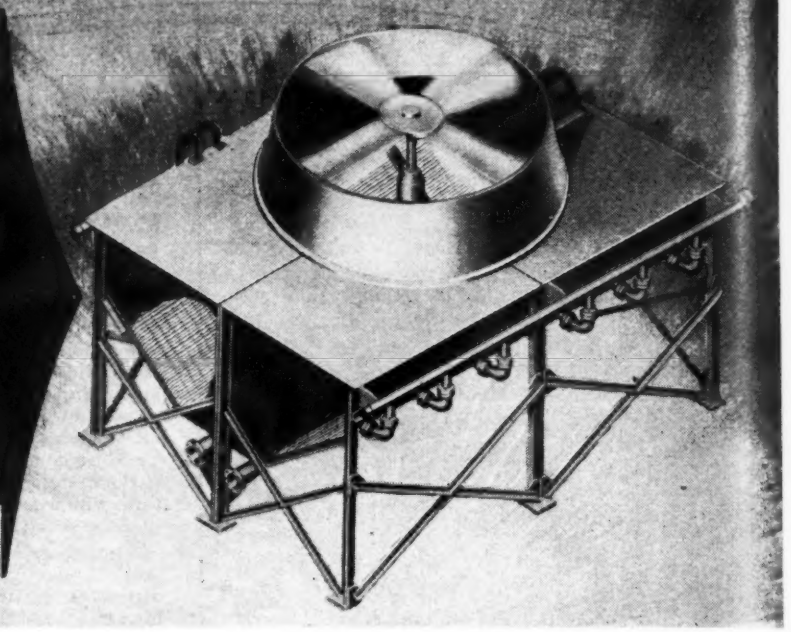
Efficient Cooling Without Water—

THE NEW ALCO AIR-COOLED HEAT EXCHANGER WILL DO THE JOB BETTER



Here's why:

1. Works at high air temperatures—reliable at all seasons of the year.
2. Extended-finned heat-transfer surfaces.
3. Uniform air distribution by induced draft—high-velocity, vertical discharge prevents recycling of hot air.
4. Because of design, efficiency is not affected by change of wind direction.
5. Not affected by high humidity.
6. Design and construction make field assembly and erection easy and quick.
7. Sturdy steel construction—ample safety factor against high winds.
8. Minimum operating and maintenance expense.
9. Engineered for your specific application from a selection and combination of four standard sizes and five standard coil or core designs for each frame size.
10. In restricted areas the equipment can be mounted on top of existing structures.
11. Recommendations for equipment supplied may be based on a special survey of conditions peculiar to your application by experienced ALCO thermal engineers.
12. Designed, built, sold, guaranteed and serviced by ALCO—with more than 20 years of experience in thermal engineering.

Typical Applications:

1. Jacket water for Diesel and gas engines.
2. Lubricating oil cooling—cools crank case oil in Diesel and gas engines.
3. Cooling gears in large gear boxes, speed reducers, etc.
4. Steam condensing—steam engine, process steam.
5. Gas cooling and vapor condensing—chemical plants, petroleum refineries, etc.
6. Heat-treating metals—cooling bath.
7. The standard air cooled exchanger can be arranged to perform several services simultaneously—such as cooling lube oil, jacket water and gas.

Practical Problems this ALCO Equipment overcomes include:

1. Insufficient water supply.
2. Scale from bad or brackish water.
3. Elimination of expensive water treatment.
4. Waste water disposal difficulty.
5. High-cost water and pumping.
6. High relative humidity.
7. Limited installation space.

Write for new ALCO bulletin No. 1035

This equipment is fully described and illustrated in a new ALCO Bulletin, now ready. Contains standard specifications. Copy sent promptly on request. Write for your copy now.

American Locomotive

ALCO PRODUCTS DIVISION

30 Church Street, New York 8, N. Y.

Dunkirk, N. Y.

A GIANT STRIDE FORWARD

IN HEAT INSULATION!

NEW

LIGHT DENSITY

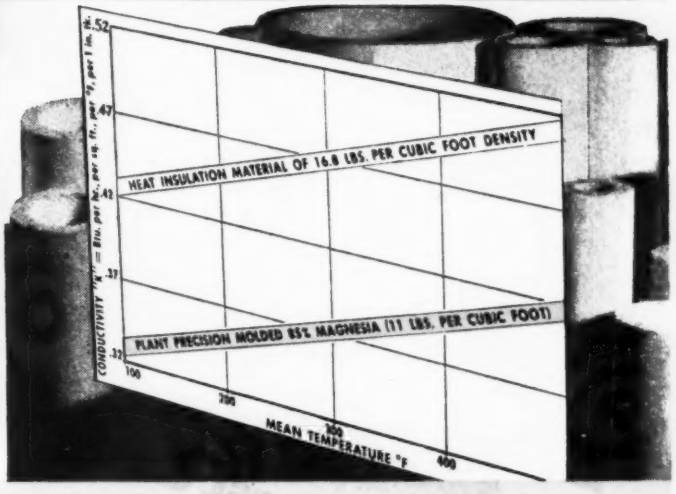
TYPE

PLANT PRECISION MOLDED

85% MAGNESIA

"THE DEPENDABLE STANDARD—MODERNIZED"
REG. U.S PAT. OFF.

WEIGHS JUST 11 POUNDS PER CUBIC FOOT

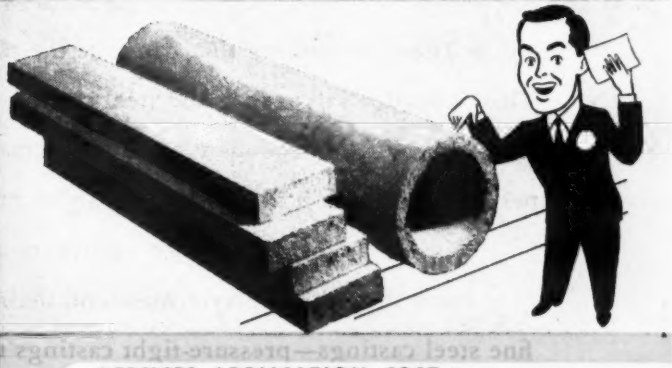

HEAT INSULATION MATERIAL OF 16.8 LBS. PER CUBIC FOOT DENSITY
PLANT PRECISION MOLDED 85% MAGNESIA (11 LBS. PER CUBIC FOOT)
MEAN TEMPERATURE °F

SAVES MORE FUEL—MORE HEAT—THAN EVER BEFORE!
Sets new low in Thermal Conductivity over the full range of temperatures!

NOW

there's a new, high standard of performance in every field of heat insulation... and it's all due to this light-density type PRECISION MOLDED 85% Magnesia!

Thanks to the special, patented Plant process *, the natural insulation superiorities of 85% Magnesia are revolutionized with unprecedented advancements for applicator, engineer and user! Specify for your post-war projects. Write today for complete data.



REDUCES APPLICATION COST because it goes on faster and easier! Light to lift. Easy to cut and cross-score. Greater "ductile strength", too!

*U. S. Patents Nos. 2,131,374, 2,209,752, 2,209,753, 2,209,754.

PLANT
RUBBER & ASBESTOS WORKS

MAIN OFFICE: SAN FRANCISCO

SALES OFFICES in Los Angeles, Wilmington and Oakland, California and Houston, Texas; distributors in principal cities.
FACTORIES in Emeryville, San Francisco and Redwood City, California.

COMPLETE RANGE OF SIZES and thicknesses in blocks and pipe coverings (up to and including 18 inch pipe size in sectional form. Larger sizes in segmental form).

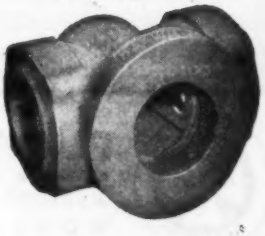
Army-Navy "E" Awarded to FACTORY No. 3 Emeryville, Calif.

Manufacturers of Plant Insulating Materials and Mechanical Packings. Established 1898.

35 YEARS

OF SPECIALIZED STEEL CASTING EXPERIENCE

SIVYER STEEL CASTINGS



• There is nothing that can take the place of experience. This is particularly true in the steel casting business. For here, so much is dependent upon the human element. It takes experience to develop the skill necessary to make good castings. Sivyer has that experience—35 years of it. And from this come the skill of Sivyer men, and their ability to produce fine steel castings—pressure-tight castings that give maximum service. Critical buyers know that the Sivyer diamond on a steel casting is worth looking for.

ARMY E NAVY

CASTING COMPANY
MILWAUKEE CHICAGO

One *furrow* . . . one *faith*

No man can be master of all things. He may do many things well . . . even with considerable skill. ☆ But the true craftsman, the gifted creator, the great artist will always be found to have concentrated his genius in a *particular* field of endeavor. ☆ Back of any lasting work of literature or scientific development . . . behind the painted masterpiece or great industrial accomplishment, there is invariably singleness of purpose . . . unyielding devotion to one goal. ☆ In art and industry . . . in the creative loneliness of vision . . . *dedication to a single ideal is the road to achievement.* ☆ And when, in addition, that ideal is made into a dynamic, vibrant reality by men of energy and ability . . . the result is human progress. ☆ For more than 40 years, Dr. Willis H. Carrier and his associates have devoted themselves to the art and science of air conditioning and refrigeration.

CARRIER CORPORATION ☆ SYRACUSE, NEW YORK

INTERCHANGEABLE

INTERRELATED RANGE TUBES

THE easy range-changing feature of the Brown Mechanical Flow Meter has proved to be of great advantage to users.

If the original flow estimate is found in error (as it is in many cases) or if the average rate of flow changes (as it frequently does), the orifice need not be disturbed, nor another meter body installed to obtain the required range. With the Brown Mechanical Flow Meter all that is required is to install a *new range tube* of proper size in the meter body and use a chart of matched range in the recorder.

Range tubes make range changing easy—quick—inexpensive—no shutdowns or loss of records.

Seven interchangeable range tubes make it possible to get a four to one change in meter capacity in steps of roughly 25 per cent.

With Brown Flow Meters, you can correctly determine the cost of making steam for power, processing or heating and properly allocate costs to departments or units. Brown Flow Meter chart records show the rate of steam flow which enables operators to maintain the most efficient boiler operation, thus effecting substantial fuel savings.

Write for Catalog 2204, THE BROWN INSTRUMENT COMPANY, a division of Minneapolis-Honeywell Regulator Company, 4490 Wayne Avenue, Philadelphia 44, Pa. Offices in all principal cities, 119 Peter Street, Toronto, Canada—Wadsworth Road, Perivale, Middlesex, England—Nybrokajen 7, Stockholm, Sweden.

BROWN FLOW METERS
. . . MINNEAPOLIS-HONEYWELL CONTROL SYSTEMS . . .

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

Highly Corrosion-Resistant Copper-Base Alloys

for Marine Refrigeration and Air Conditioning

With the war has come new realization of the vital roles which refrigeration and air conditioning play on board surface ships and submarines. In addition to food preservation, the air conditioning of large portions of living and working space, maintenance of proper humidity and temperature control for stored ammunition and other material are factors of the greatest importance. Marine refrigeration and air conditioning undoubtedly will be used even more widely in the future.

Many Future Benefits

The successful shipment of perishable foods to our fighting men overseas is only a prelude to what promises to be a tremendous industry in the postwar years. Quantities of foodstuffs will be preserved during their journey across vast oceans by large, efficient refrigeration and air conditioning installations. Fishing vessels will be equipped to "deep freeze" while at sea. The natural goodness of tropical fruits and vegetables will be preserved by more effective refrigerating technics. Crews and and passengers will enjoy the benefits of more healthful living and working quarters through more general use of air conditioning equipment.

Corrosion Worse On Shipboard

Copper-base alloys play an important part in the pumps, motors, piping, tubing, controls, ducts, nuts, bolts, fastenings, and other equipment involved in such installations. However, at this time let us consider only those applications involving piping and tubing together with the corrosion problems encountered. Tubing corrosion problems are intensified on board ship because circulating sea water is used in condensers and coolers, and because the effects of condensation on the surface of pipes is more severe in the presence of salt laden air.

Other corrosion problems are encountered in refrigeration as the liquid refrigerant, such as Freon is conducted through tubing or piping to the point of vaporization, compressed to a higher temperature level, then conducted through tubing or pipes to a condenser, where the hot gases are cooled and condensed by flowing on the outside of tubes through which sea water is circulated. Here impingement corrosion is encountered when water velocities are high.

Many Factors In Tube Selection

The pipes and tubing involved in this cycle must, of course, be carefully selected. For condensers in refrigerating systems where water velocities are not too high, an alloy like Arsenical Admiralty gives satisfactory service with salt water. With higher velocities, Cuzinal (Aluminum brass) with its superior resistance to air impingement, gives better results than Admiralty. For severe conditions, Duronze IV has exceptional resistance to general corrosion and impingement attack, and is considered one of the finest condenser tube alloys made. Cupro Nickel is recommended in connection with high velocity clean sea water when impingement corrosion is very severe.

While Duronze IV is particularly recommended for surface condensers in power plants where water conditions are exceptionally bad, it might well be a good choice for condenser tubing in refrigeration installations on coast line ships, traveling continually in waters where corrosion is intensified by wastes from cities.

Consider Type of Refrigerant

Other piping and tubing in refrigeration and air conditioning systems require equally careful consideration. Where ammonia refrigerants are used, for example, it is obvious that a leak aboard ship might have extremely serious consequences. In such systems, duplex tubing is recommended, with steel for the ammonia side and a copper-base alloy on salt water side.

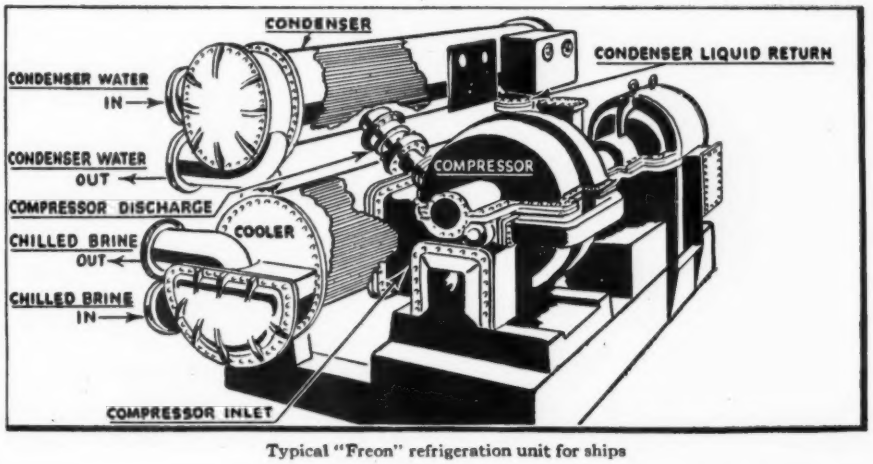
For moisture-free refrigerants of the Freon type, standard copper-base condenser tube alloys are satisfactory.

Bridgeport Copper Tubing

Copper tubing is very useful in air conditioning and for general piping. It does not rust. Solder type and brazed type connectors withstand vibration and do not loosen up as easily as threaded fittings. Installation is simplified by its light weight, ease of bending, solder type fittings (brazed with silfos solder when used for refrigeration gases), and the convenient coils in which it comes.

Condenser Tube Manual

Bridgeport's Condenser Tube Manual contains specifications for modern condenser tube alloys, corrosion research data, facts about duplex tubing and copper tubing plus other important information. Be sure to write for your copy.



Typical "Freon" refrigeration unit for ships

Note: Bridgeport products are supplied in accordance with existing priority regulations.

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN.

ARMY E NAVY

BRASS

ESTABLISHED 1865

SURFACE CONDENSERS

For over twenty-five years Graham engineering has been recognized as a leading influence in the surface condenser field. The first all welded steel plate shell surface condenser, the integral tube sheet, the combined waterbox and shell, the improved twin bank tube arrangement, the built-in atmospheric relief valve, the bushed support plate, *positive reheating above steam temperature;* these are only some of the important Graham contributions to the art of better condenser design.

Shown above are some of the several hundred trial run reports of Uncle Sam's ships on which complete Graham Condensing Plants are installed. A survey of these reports shows an average of 6 degrees of positive reheating, by comparison of Main Turbine Exhaust Temperature and Discharge Temperature from Main Condensate Pumps.

AWARDED THE MARITIME "M" PENNANT AND VICTORY FLEET FLAG APRIL 8, 1944

GRAHAM MANUFACTURING CO., INC.

415 LEXINGTON AVENUE • NEW YORK 17, N. Y.

for Castable Refractory Users

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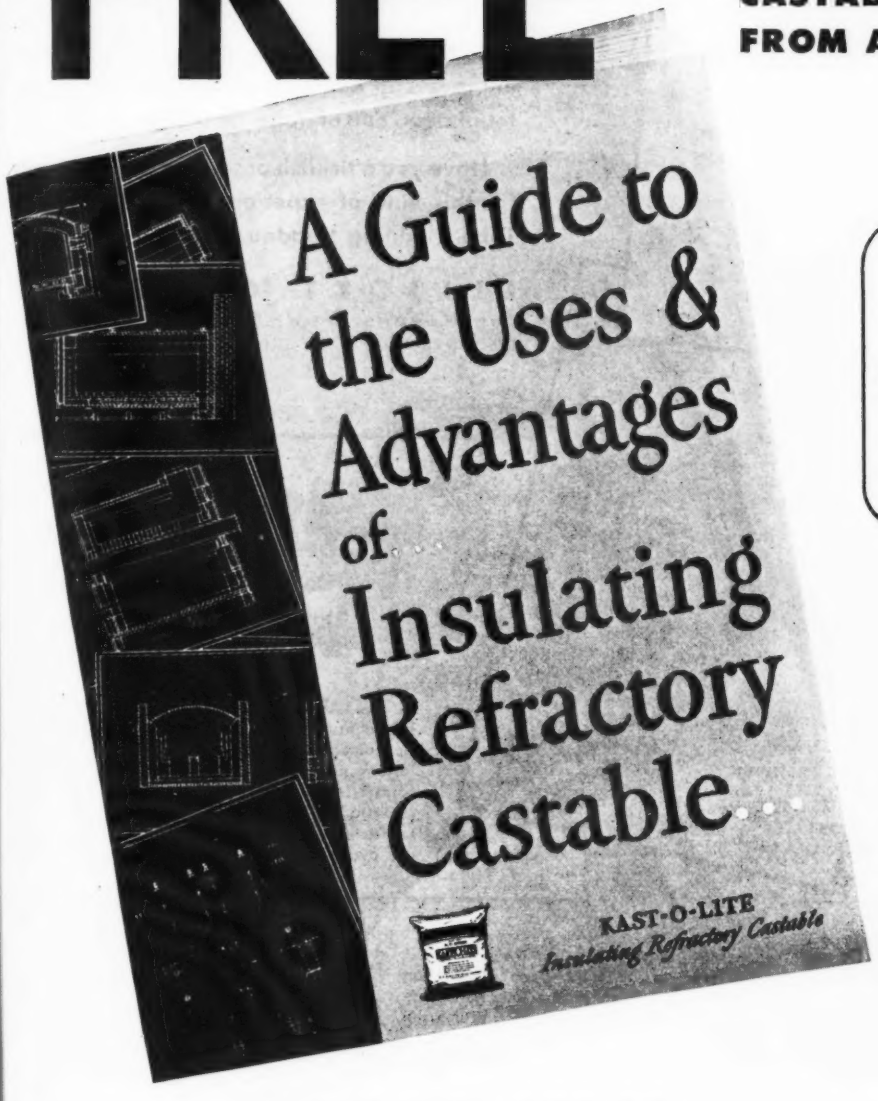
A NEW 24-PAGE INSULATING-REFRACTORY-CASTABLE DATA BOOK FROM A. P. GREEN



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CASTABLE ADVANTAGES
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TELLS YOU

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A. P. GREEN
FIREBRICK COMPANY
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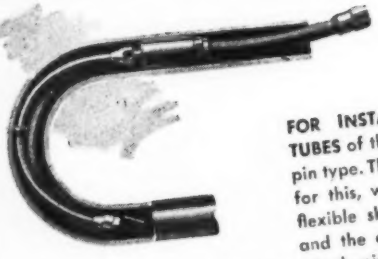
TRICKY TUBE CLEANING made easy

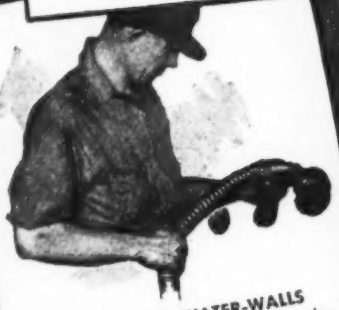


FOR INSTANCE, SUPERHEATER TUBES of the return bend or hair-pin type. There is an Elliott cleaner for this, with a length of strong flexible shaft between the motor and the cutter head, which may be a threaded cone or a single-pin head. The motor does not have to go round the bend, which is cleaned halfway around from each straight portion of the tube.

Here are just a few examples which serve to show the versatility of Elliott tube cleaners, and the alertness and ingenuity of Elliott engineers in devising methods that take the toughness out of tube cleaning.

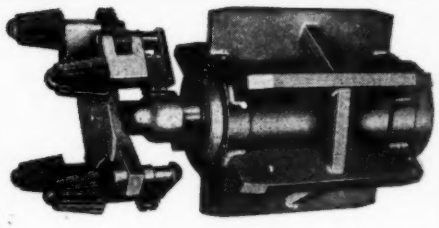
Have you a ticklish or unusual job that calls for this kind of experience? Take it up with Tube Cleaning Headquarters.

ELLIOTT COMPANY
Tube Cleaner Dept., **SPRINGFIELD, OHIO**
DISTRICT OFFICES IN PRINCIPAL CITIES

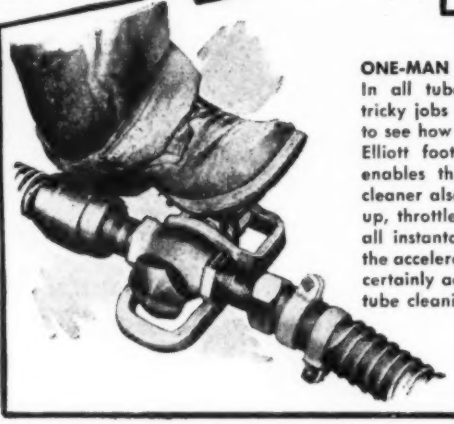


TO CLEAN WATER-WALLS Not really a tricky job, as the cleaning of side-, floor-, and water-wall tubes is common procedure using the agile and powerful Elliott 1300 Series motor with universal joint and proper Elliott cutter head. This equipment has flexibility to reach two tubes through one hand-hole opening.

BIFURCATED TUBES, TOO can be difficult — but not with this special equipment, which includes a guide to direct the cleaner into either tube. The guide threads into the tube, and can be turned and locked in the desired position. A flat on the end of the unit indicates the direction of the guide.



LARGE TUBE AND PIPES Not a usual job around a power plant, but sometimes necessary as in new installations, to remove sand, mill scale or weld sputter from fabricated pipe. The picture shows a 4¾ in. motor with special sleeve for entering 10 in. pipe. Cutter heads are available up to 20 inches.



ONE-MAN CLEANER CONTROL In all tube cleaning, but on tricky jobs especially, it is easy to see how vitally helpful is the Elliott foot-throttle valve. This enables the man guiding the cleaner also to start it, speed it up, throttle it down, or stop it, all instantaneously. Works like the accelerator on an auto—and certainly accelerates any job of tube cleaning.

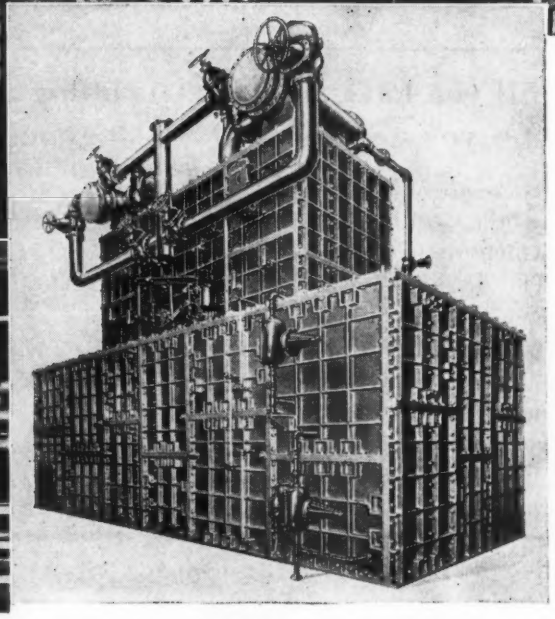
All the above developments, and many more, described in the new Elliott Book on Tube Cleaning —on request.

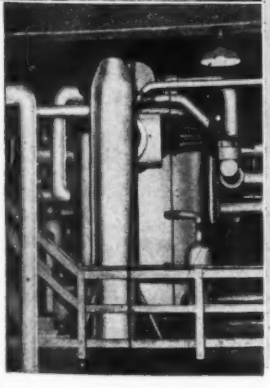
V-235

ELLIOTT Company

STEAM TURBINES • GENERATORS • MOTORS • CONDENSERS • FEEDWATER HEATERS AND DEAERATORS • STEAM JET EJECTORS • CENTRIFUGAL BLOWERS • TURBOCHARGERS FOR DIESEL ENGINES • TUBE CLEANERS • STRAINERS • DESUPERHEATERS • FILTERS

COCHRANE Deaeration SAVES!





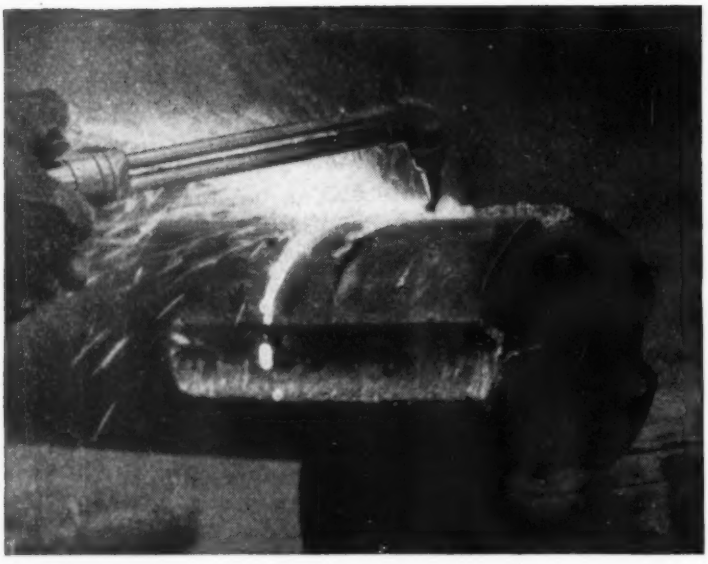
Deaeration of boiler feedwater is one of the big items of economy in power plant operation.

Cochrane Deaerators of varying sizes, designs and construction have been protecting the boiler plants of industry for many years. The feed piping, economizers, water walls and tubes of these boilers are effectively protected by Cochrane Deaeration, which removes both dissolved oxygen and soluble gases, and at the same time produces savings in heat and fuel by heating the water to the boiling point.

COCHRANE CORPORATION 3106 N. 17th ST., PHILADELPHIA 32, PA.

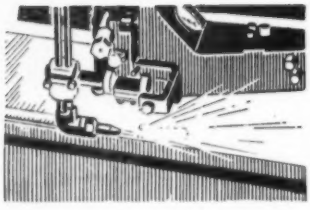
COCHRANE

SOFTENERS · DEAERATING SOFTENERS · DEAERATORS · METERS · STEAM SPECIALTIES

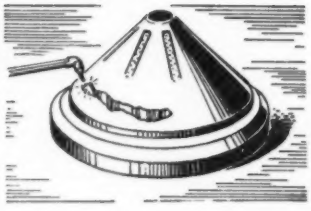


Shaped-to-Fit by FLAME-GOUGING

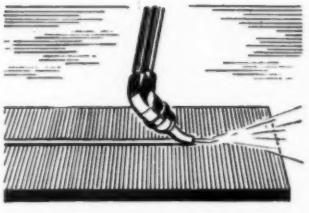
Many parts can be made out of stock steel by oxy-acetylene flame-gouging. This shaft end is being grooved to fit a clutch. Each splineway, 3 in. wide and 12 in. long, is finished in 8 minutes.



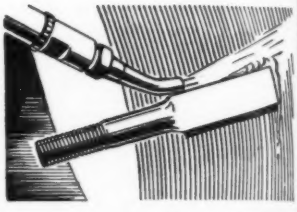
Flame-gouging takes the place of machining in preparing plate edges for welding.



. . . is the fastest way to prepare cracks in steel castings for reclamation by welding.



. . . is a quick and economical way to make oil grooves in steel plate.



. . . replaces grinding and chipping in the removal of temporary welds.

Flame-Gouging: Is quick... easy... quiet... and economical

If you have an OXWELD cutting blowpipe, all you need is an OXWELD gouging nozzle

There are only three sizes. They differ in the width and depth of gouge which they will make in one pass. The determining factor is the diameter of the cutting orifice — 1/8 in., 3/16 in., 1/4 inch. Write for the catalog, "Oxweld Blowpipes," Form 4488, for more information about OXWELD gouging nozzles.

BUY UNITED STATES WAR BONDS AND STAMPS

MARITIME "M" AWARD FOR OUTSTANDING PRODUCTION ACHIEVEMENT

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

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In Canada: Dominion Oxygen Company, Limited, Toronto

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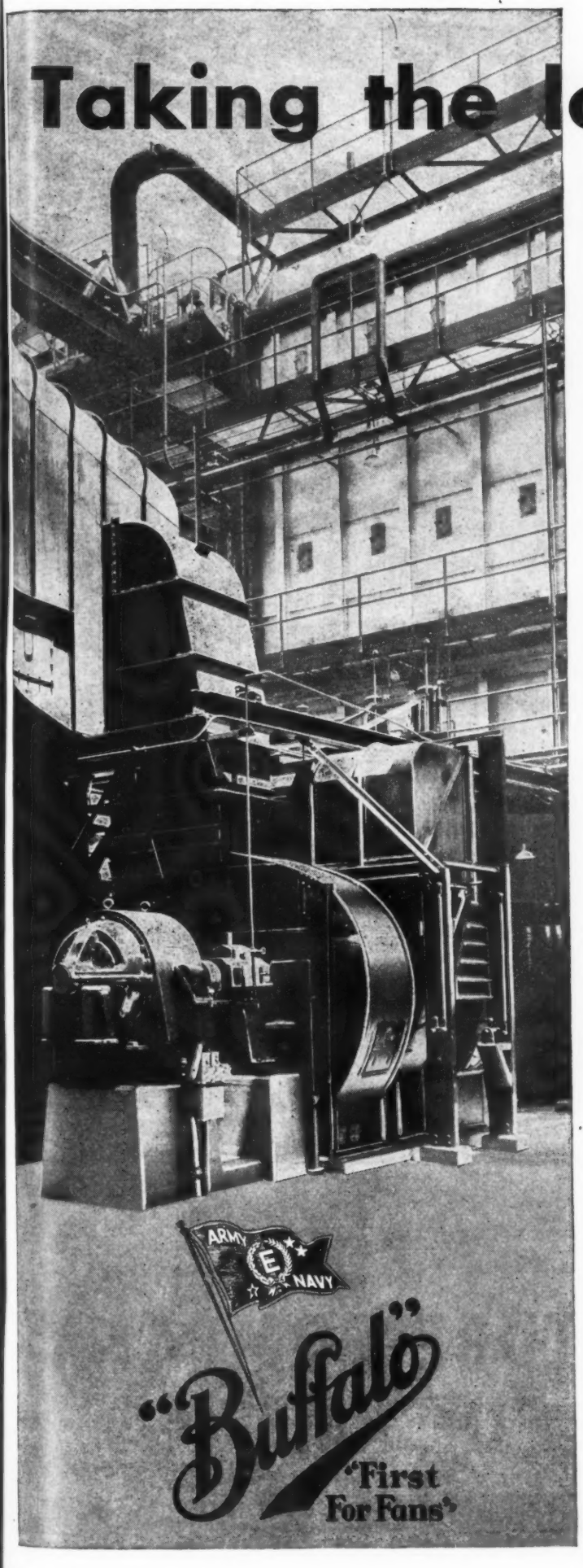
The words "Linde," "Oxweld," "Prest-O-Lite," "Prest-O-Weld," "Purox," "Union," and "Unionmelt" are trade-marks of Union Carbide and Carbon Corporation or its Units.

Taking the long view -



Power plant engineers know that the first cost of equipment is not nearly as important as the operating and maintenance cost of that equipment. Over a period of years, the extra cost of the *very best* draft fans can be saved many times over—by higher efficiency—by longer life of rotors and housings—by easier maintenance. During recent years, the "easier maintenance" construction of Buffalo fan housings has saved many headaches for operating engineers working with reduced crews. The long life of Buffalo rotors and housings is well known to the industry—and Buffalo efficiencies are high enough to meet the most exacting requirements.

Buffalo engineering sales representatives located in all principal cities will be glad to give you detailed information on the construction and performance to be expected from Buffalo Forced and Induced Draft Fans.

BUFFALO FORGE COMPANY

488 Broadway **Buffalo, N. Y.**

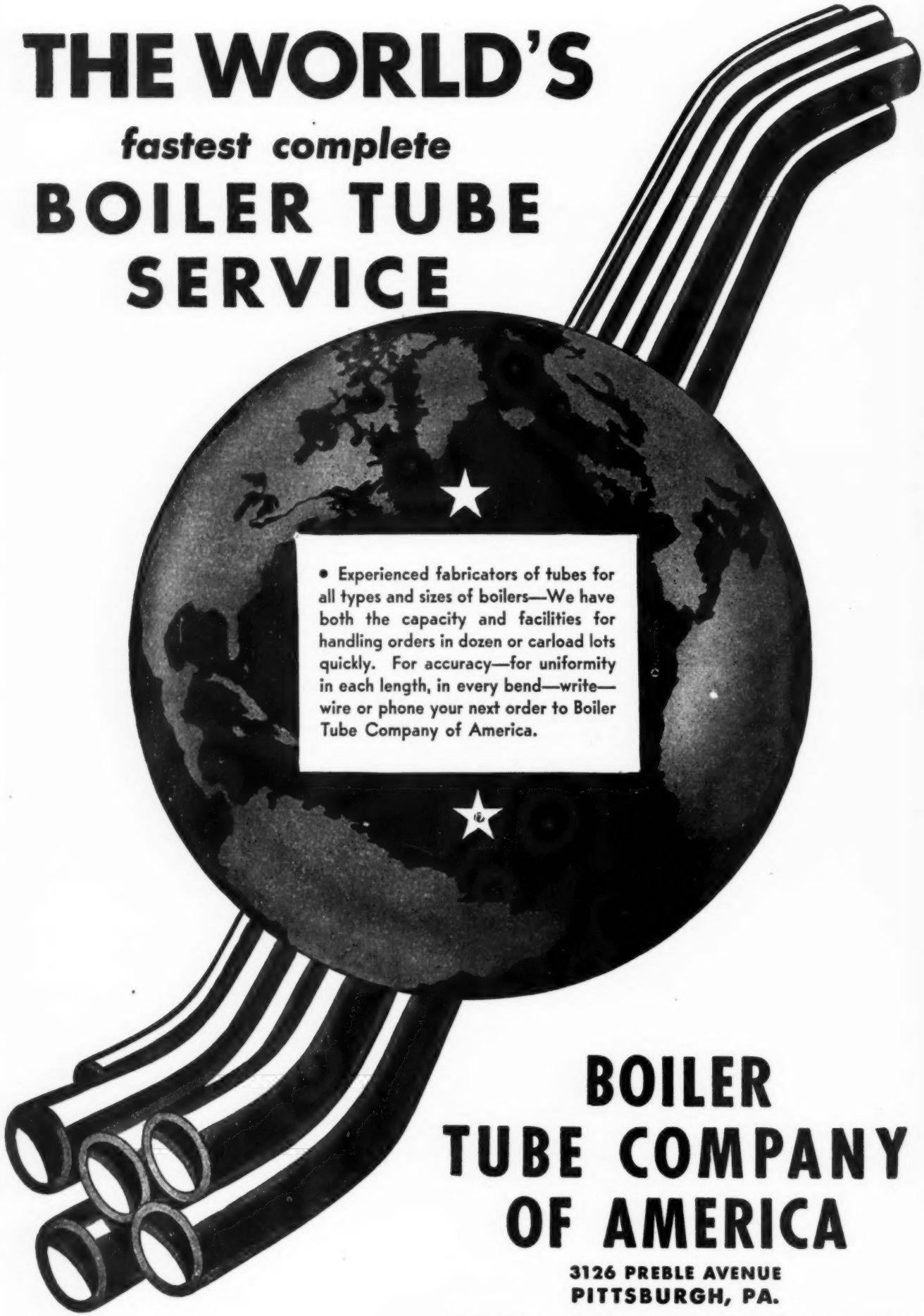
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

DRAFT FANS

THE WORLD'S

fastest complete

BOILER TUBE SERVICE



• Experienced fabricators of tubes for all types and sizes of boilers—We have both the capacity and facilities for handling orders in dozen or carload lots quickly. For accuracy—for uniformity in each length, in every bend—write—wire or phone your next order to Boiler Tube Company of America.

BOILER TUBE COMPANY OF AMERICA

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PITTSBURGH, PA.

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THE TUBE THAT MADE

MECHANICAL-ELECTROSTATIC

DUST COLLECTION POSSIBLE

THE Duplex Dust Collector is like a double-barreled shotgun! "Why?"

Because it takes two barrels to get real results—the second barrel hits what the first one misses.

That, briefly, is the story of the new Thermix Duplex Collector. It combines *both* mechanical and electrostatic principles but its size is only slightly larger than the conventional mechanical units. And it *gets* results—94.66% *total* dust elimination, as proved by actual tests on extremely fine pulverized fuel dust! Dust escaping from this collector need never worry you even if dust ordinances and health requirements become increasingly severe. It solves your problem—economically—once and for all.

If desired, only the mechanical section of the Thermix-Duplex need be installed at the outset. Should greater efficiency be required, the secondary section can be added at any time. Furthermore, the Duplex is so designed that the mechanical unit *alone* will give high dust collection while the circuit of the electrostatic unit is being cleaned.

Write for bulletin giving engineering data.

•

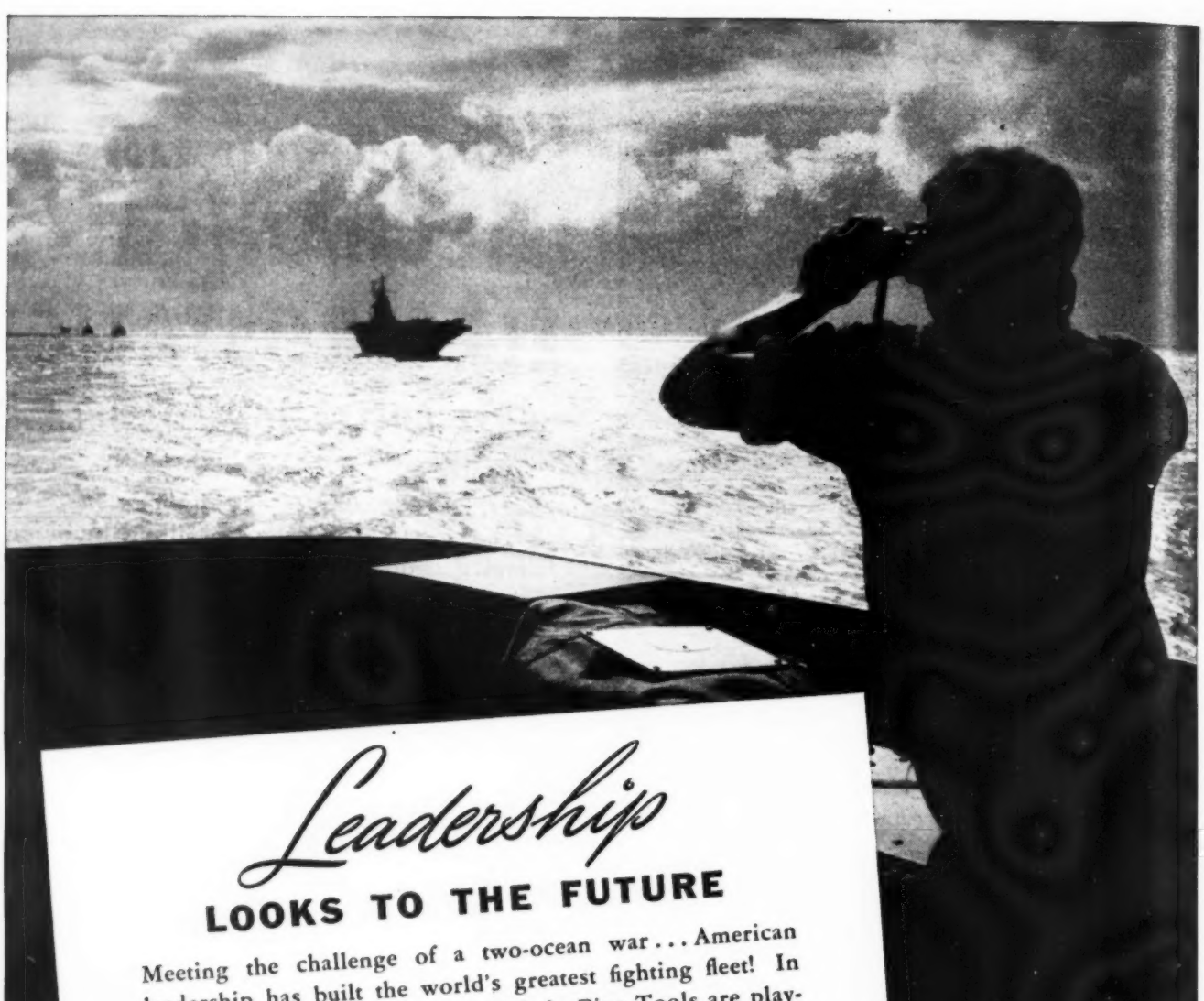
THERMIX ENGINEERING COMPANY

Project and Sales Engineers

FIRST NATIONAL BANK BLDG., GREENWICH, CONN.

PRAT-DANIEL CORPORATION

EAST PORT CHESTER, CONN.



Official U.S. Navy Photo

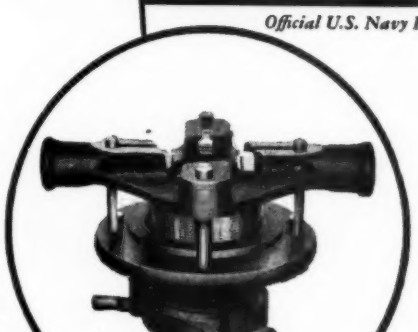
Leadership

LOOKS TO THE FUTURE

Meeting the challenge of a two-ocean war . . . American leadership has built the world's greatest fighting fleet! In shipyards building this fleet . . . Toledo Pipe Tools are playing their part in this tremendous war job. The challenge to improve pipe threading devices has been constantly before Toledo Engineers for nearly half a century. Early success—born of sweat and inspiration—brought forth the first of the new-principle easy-operating threaders—and these Toledo Tools have continued to be the standard of the industry ever since! Whatever your needs in pipe tools today . . . and tomorrow . . . specify TOLEDO!

TOLEDO

PRECISION PIPE TOOLS

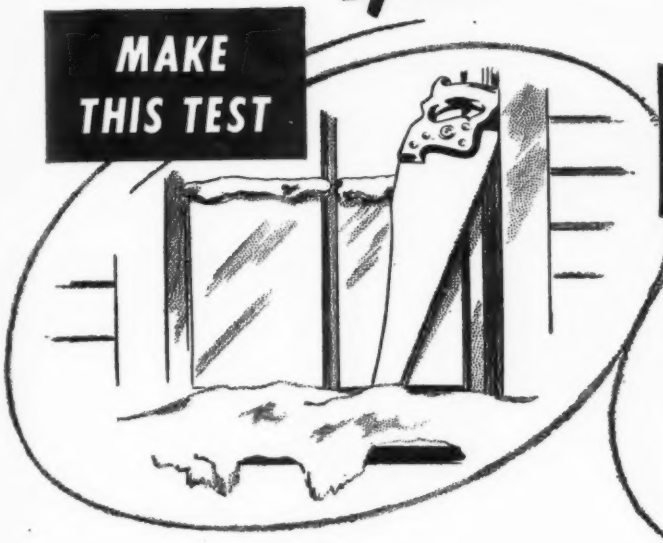


Unbeatable... ADJUSTABLE THREADER!

The popular TOLEDO No. 1 Plain (shown here) and No. 1A Ratchet 1" and 2" threaders designed with receding die principle, standard with experienced pipe tool users for years. Easy cutting . . . produce smooth, standard taper pipe threads. Separate dies for each size pipe—2" dies of high speed steel. "Tops" for dependability and low cost! The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office, No. 2 Rector Street Building.

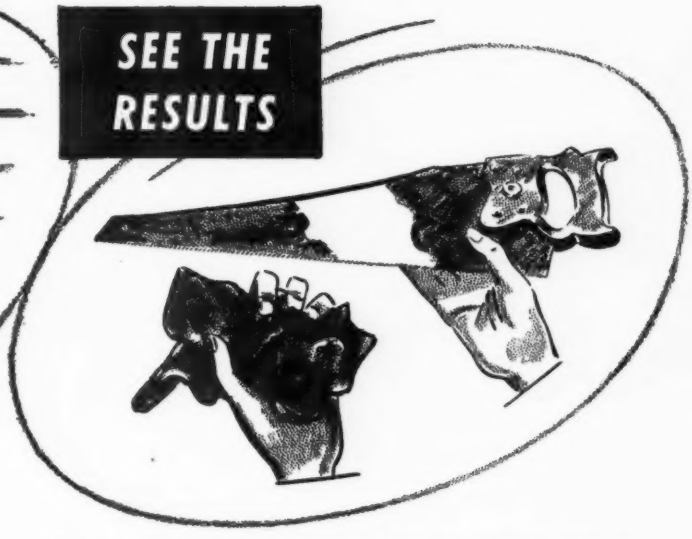
How to *prevent* Corrosion

MAKE THIS TEST



Coat a section of any piece of raw metal with a protective film of Anti-Corrode. Place it out-of-doors, and leave exposed to the elements.

SEE THE RESULTS



Rain, snow, changing temperature, dust and grime have eaten into and oxidized the unprotected metal. But note surface under Anti-Corrode film—bright and unharmed, in its original state.

CITIES SERVICE **ANTI-CORRODE** is a safe rust and corrosion preventive that brings amazing results. It is a reliable safeguard against corrosion of metals in any form or state of finish—whether in storage or in transit. Anti-Corrode forms a tenacious, durable film that is impervious to moisture and the more common gases prevalent in the atmosphere. And, since it contains lubricating material, it need not be removed in drawing operations. Anti-Corrode is made in several grades to meet specific requirements and severest tests. It is economical, easy to apply and can be removed with kerosene or any petroleum solvent.

This TEAM Will Save You Money and Materials

Recently, we announced the development of Cities Service Rust Remover, and responses to the demonstration offer far exceeded our expectations. Rust Remover, of course, *removes* rust. Anti-Corrode is designed to *prevent* rust and corrosion. Together, they will safeguard your equipment and war production—for the duration!

Take advantage of this FREE ANTI-CORRODE demonstration offer
Mail this coupon today!

(Available only in Cities Service marketing territory EAST of the Rockies.)

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NEW YORK • CHICAGO

IN THE SOUTH
ARKANSAS FUEL OIL COMPANY
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CITIES SERVICE OIL COMPANY
Room 229, Sixty Wall Tower, New York 5, New York

Gentlemen: I would like to test Anti-Corrode on my own equipment FREE OF CHARGE. Please send me the details.

Name_____

Company_____

Address_____

City_____ State_____

"Defenders of Steam"

ORIGINAL LITHOGRAPH BY BENTON SPRUANCE

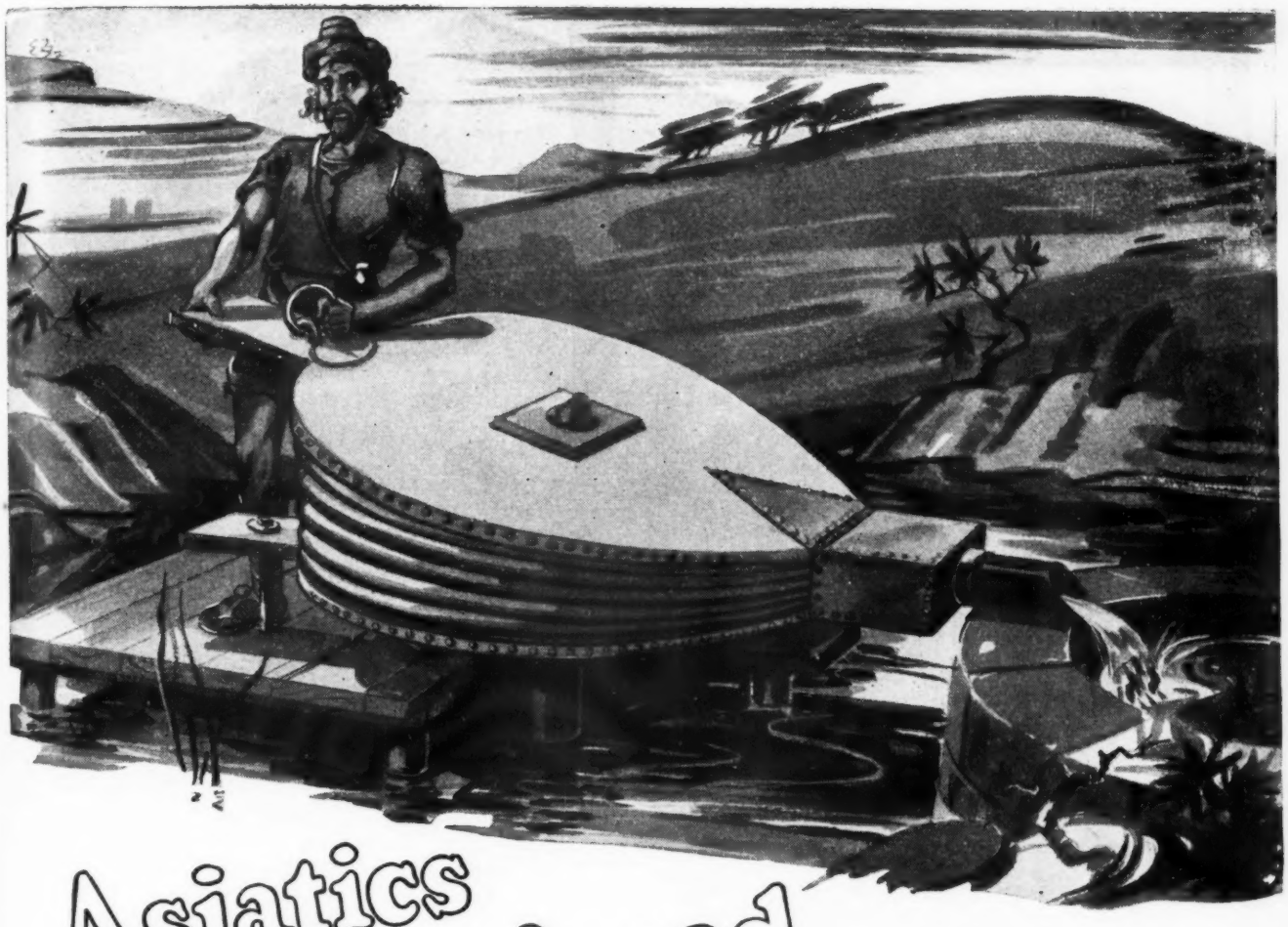
There is not a steam ship afloat, a power plant ashore, or a process industry anywhere that does not depend upon thermal insulations for its operation. In fact, the modern boiler and power plant could not function without the coverings that defend against heat loss and temperature drop. To exist, industry must insulate. • The work done by the men who make and the men who apply good insulations lives long after them. For example, countless pipe coverings and blocks of Ehret's 85% Magnesia that were applied before the turn of the last century are still doing 24-hour service today, with no end of their useful life in sight. This is a fact that is satisfying both to we who made them and to those who bought them.

THE EHRET HEAT INSULATION HANDBOOK *contains a wealth of information on 85% Magnesia, Enduro high temperature and many other insulations—with selection and application data for boilers, piping and equipment. Fully illustrated, it includes heat loss and efficiency tables, specifications and recommendations for every temperature condition. A copy will be sent at your request.*

EHRET

MAGNESIA MANUFACTURING CO.

VALLEY FORGE • PENNSYLVANIA



Asiatics Acclaimed this "Modern" Water Elevator

IMAGINE yourself living four thousand years ago, pumping water with this new Persian invention. What a wonderful improvement it was over lifting water a jugfull at a time from the stream-bed...to irrigate crops or to carry home.

But the world left Persia and this marvelous labor-saving water elevator far behind. Why?

Because the western world discovered plentiful supplies or iron ore, learned how to make steel, how to fabricate it into pipe, sheets, plates, rods, wire, etc., and how to manufacture an endless variety of products that would amaze and confound those ancient Persian inventors. Pumps, valves, tanks, piping and other parts of modern water supply systems are possible for everybody only because steel manufacturers, such as Youngstown, have developed ways to produce steel and steel products in tremendous quantities, at a cost within reach of everyone.

So when you buy or use a piece of steel pipe, inexpensive and commonplace though it is, you may well realize that without our abundance of excellent steel we in America today might be using the ancient Persian water elevator-and still calling it modern.

QUALITY YOUNGSTOWN SERVICE

YOUNGSTOWN

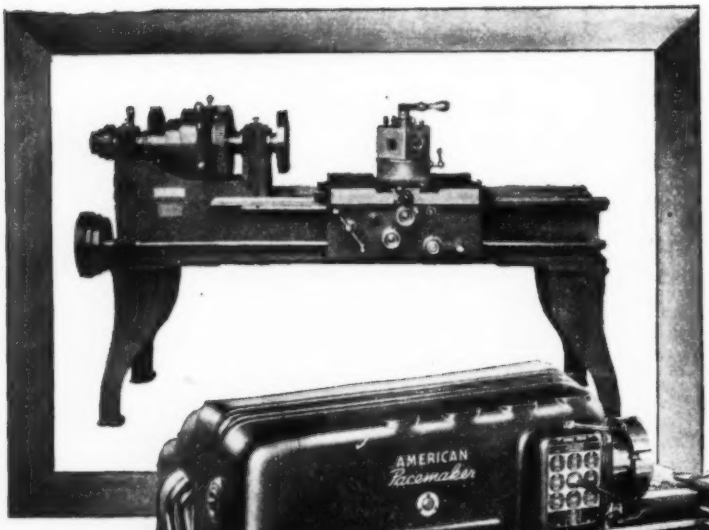
THE YOUNGSTOWN SHEET AND TUBE COMPANY

YOUNGSTOWN, OHIO

Manufacturers of

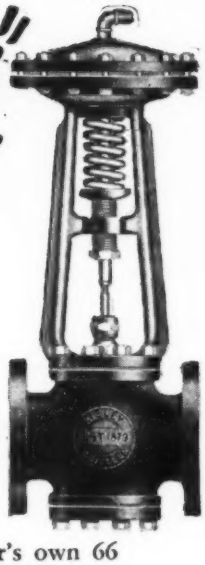
CARBON - ALLOY AND YOLOY STEELS

Pipe and Tubular Products - Sheets - Plates - Conduit-Bars-Coke Tin Plate-Electrolytic Tin Plate-Rods-Wire-Nails-Tie Plates and Spikes.



In 1878 the founders of The American Tool Works Company began the manufacture of lathes. At left is an 1890 model. Below is the famous American Pacemaker of today, as used in the Kieley & Mueller plant.

67 years of improvement ... and "it comes out HERE"



Here? Yes, for the *real* advancement in lathe design is in the better, more accurate products those lathes make. Just as the real improvement in Kieley & Mueller Controls is not in the controls themselves . . . but in most accurate and dependable pressure regulation in actual application. So when you look at the illustration of our Type 418 Pressure Regulating Valve at the right, please look behind it . . . and *ahead!* Look behind it to Kieley & Mueller's own 66 years of experience and improvement. Look ahead to the long years of reliable performance Type 418 will give you on any standard service where inlet pressure, constant or varying, does not exceed 300 lbs. . . . and where reduced pressure range is from 1 lb. to 75% of inlet not exceeding 125 lbs. Type 418 is made in ½" to 12" sizes, single or double seated, with discs suitable for water, air, gas, oil, steam or corrosive fluids. Complete details and specifications in Catalog No. 66. Write for it.

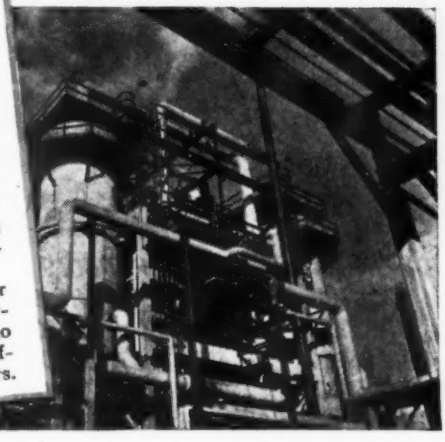
KIELEY & MUELLER, INC.

MANUFACTURERS OF PRESSURE AND LEVEL CONTROLS SINCE 1879

2001 43rd St., North Bergen, N. J.

66 YEARS OF CONTROL PROGRESS

You save time and money with ARMSTRONG'S CONTRACT SERVICE FOR HEAT INSULATION



"On stream"— in record time

To produce high-octane fuel for America's warplanes, the new $13,500,000 Sun Oil Company's Plant #15 at Marcus Hook, Pa., was rushed to completion on a fast schedule.

Mile after mile of lines, hundreds of vessels and heat exchangers were insulated speedily and effectively by the skilled mechanics of Armstrong's Contract Service. Here, piping and equipment which carry liquids and gases at 200° F. to 850° F. are insulated by 85% Magnesia Pipe Covering and high-temperature insulation.

Whether your job is large or small, this time- and money-saving service is available to you through Armstrong offices in most industrial centers.

YEARS OF EXPERIENCE in engineering both large and small jobs is an advantage that pays you dividends when you use Armstrong's heat insulation contract service. It assures planning and supervision that speed work and keep costs low. In addition, Armstrong's complete service provides materials of tested efficiency; also skilled, experienced mechanics for installation. Armstrong takes full responsibility for every phase of the work. For detailed information, write to Armstrong Cork Company, Building Materials Division, 7003 Concord Street, Lancaster, Pennsylvania.

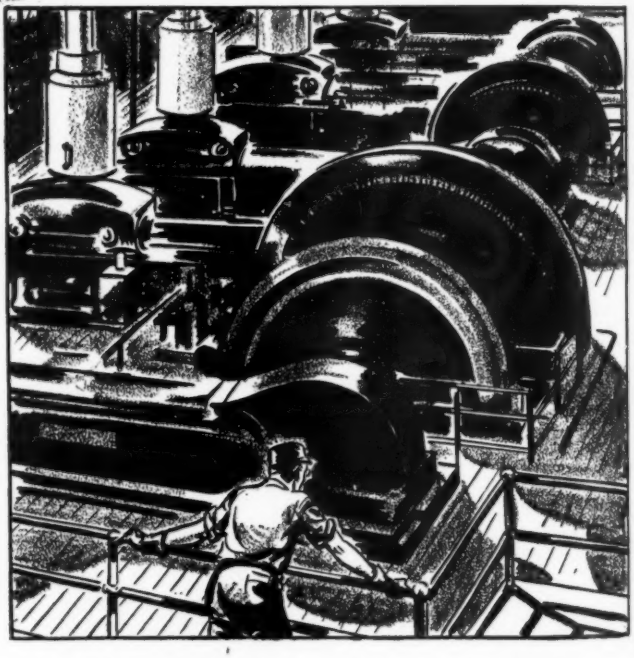
ARMSTRONG CORK COMPANY

Complete Insulation (A) Contract Service for All temperatures from 300° below zero to 2600°F.

Do you know that . . .

AMERICAN AIRLINES INC. UNDER CONTRACT TO THE AIR TRANSPORT COMMAND HAS MADE MORE THAN 4300 TRANSATLANTIC CROSSINGS . . . FOR LUBRICATION OF ITS GREAT FLAGSHIP FLEET, AMERICAN USES SINCLAIR PENNSYLVANIA MOTOR OIL.

CRUDE OIL AND FINISHED PRODUCTS TRANSPORTED DAILY THROUGH THE SINCLAIR PIPELINE SYSTEM WOULD FILL 318,400 55-GALLON DRUMS. THESE, STACKED END ON END WOULD BE 31 TIMES HIGHER THAN MT. EVEREST. SINCLAIR USES OLDEST CRUDES TO MAKE HIGHEST QUALITY LUBRICANTS.



LUBRICATION FOR FULL DELIVERY OF POWER UNDER CONTINUOUS HEAVY DUTY OPERATION IS PROVIDED BY SINCLAIR STEAM CYLINDER AND VALVE OILS. THEY SUIT ALL ENGINE DESIGNS AND OPERATING CONDITIONS.

SINCLAIR *IS EQUIPPED TO SERVE YOU BETTER!*

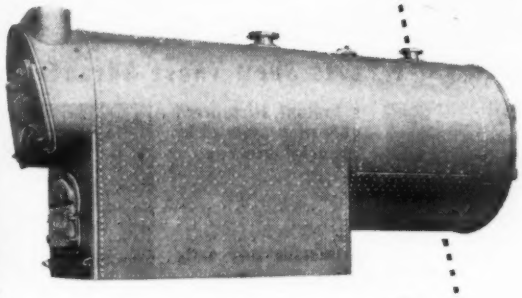
FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.

Sanstack Boilers

a complete packaged unit

READY TO ATTACH TO OIL, WATER AND ELECTRIC LINES . . .

and operate



TITUSVILLE

Boilers

. . . Are designed and built to meet every need for economical power, for heating or process steam—Water Tube Boilers, Scotch Marine Boilers, Firebox Return Tubular Boilers; Waste Heat Boilers, Boiler Burner (packaged) Units, and others to special requirements. Let Titusville Boiler engineers cooperate with you anytime, anywhere

Another outstanding Titusville boiler development—a complete steam generating plant for every heat, power or industrial processing need. Requires much less floor space than other boilers of equal rating. Can be quickly installed as an emergency or a permanent plant—that needs only regular maintenance checking. Engineer-designed for immediate response to sudden steam demands while maintaining a constant pressure throughout the system. Sizes available from 50 to 500 BPH to fit your specific requirements.

THE TITUSVILLE IRON WORKS COMPANY

Division of Struthers Wells Corporation

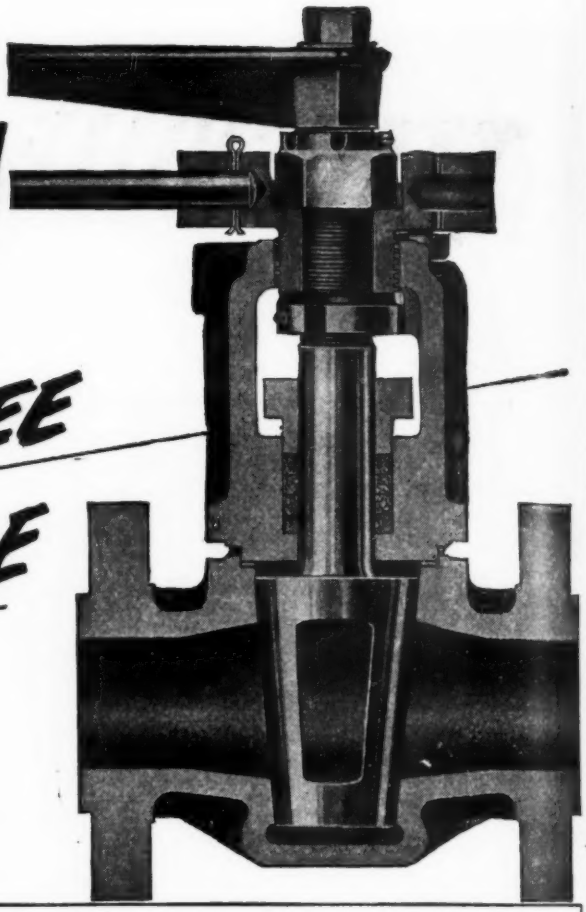
TITUSVILLE, PENNSYLVANIA

Offices in Principal Cities

6 Reasons Why

Homestead Lever-Seald Valves give

TROUBLE-FREE PERFORMANCE



Hundreds of industrial plants are meeting today's demands for economy of operation and long, unfailing performance, by replacing old, defective valves with TROUBLE-FREE Homestead Lever-Seald Valves, and specifying them for new installations.

Homestead Lever-Seald Valves are *stick-proof.* They always work! Neither corrosive or viscous fluids nor extremes of temperature or pressure can make them stick. They operate 16 to 28 times faster than screw-stem-type valves because they are fully opened or closed by a *quarter turn.* They *seal without lubricants,* and their *seating surfaces are protected from corrosion or cutting action of fluids,* both when the valve is opened or closed. Their operating parts are fully protected, too, assuring longer service and lower upkeep.

There is a Homestead Lever-Seald Valve in the right metal or alloy to suit your requirements. Write for Valve Reference Book No. 38 for Homestead Lever-Seald Valves in sizes 1½" to 10", for pressure ranges from 150 to 1500 pounds. Consult Homestead engineers on all your valve problems.

Shaded Valve Parts Show These Advantages:

1. Instant, stick-proof operation assured by powerful leverage

2. Quarter-turn fully opens or closes

3. Positive seal without lubrication

4. Seating surfaces always protected in both open and closed positions. Corrosion practically eliminated

5. Unobstructed straight-line fluid flow —minimum pressure drop

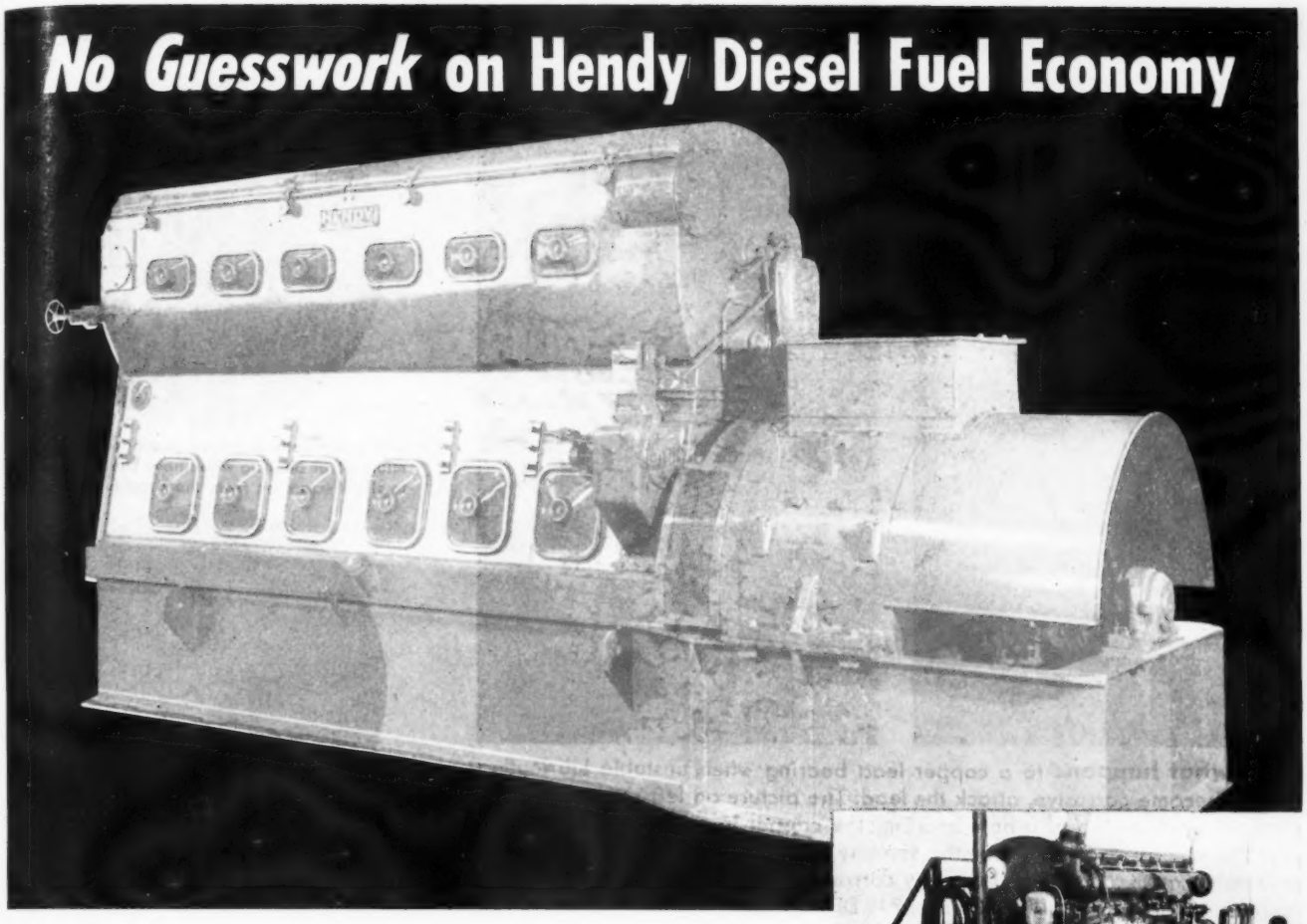
6. All operating parts protected from damaging effects of service conditions and weather.

"M" Pennant with two additional gold stars—Maritime's highest production award to our men and women making valves for the Victory Fleet.

Homestead LEVER-SEALD VALVES

HOMESTEAD VALVE MFG. CO. . . . P. O. BOX 210 . . . CORAOPOLIS, PA.

No Guesswork on Hendy Diesel Fuel Economy

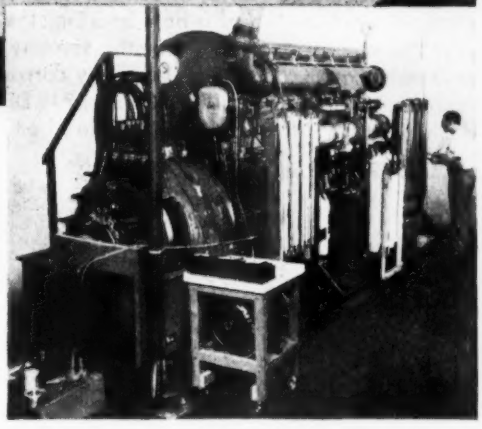


If fuel economy is a primary consideration for your new stationary power plants, investigate the *plus* performance of Hendy Series 50 Diesel-generating sets. Their quality is being demonstrated daily in the new AV1 cargo ships, where Hendy 250-kw sets (illustrated above) are giving maximum service.

Here are four basic reasons why Hendy Diesel-generating sets deliver the maximum kilowatt hours per gallon of fuel consumed:

1. **Unit-type fuel injectors assure accurately metered and timed fuel charges to each cylinder.**
2. **Oil-cooled pistons prolong piston-ring life.**
3. **Dual valves improve volumetric efficiency.**
4. **Crocker-Wheeler generators operate at high electrical and mechanical efficiencies.**

Hendy Diesel-generating sets are available in both a-c and d-c models, from 100 to 450 kw. Write for complete information, advising us of your electrical load conditions.



Laboratory set-up for checking efficiency of a Series 50 Diesel-generating set.

Proved beyond doubt or conjecture, each Hendy Series 50 Diesel-generating set exceeds a promise made by its designers—a promise to meet the operator's need for rigid fuel conservation.

More accurately than possible under field conditions, conclusive testing in the laboratory and on the test stand proved that the Hendy Series 50 Diesel-generating set operates at *high* efficiency—with *low* fuel consumption over the entire load range.

JOSHUA **HENDY** IRON WORKS

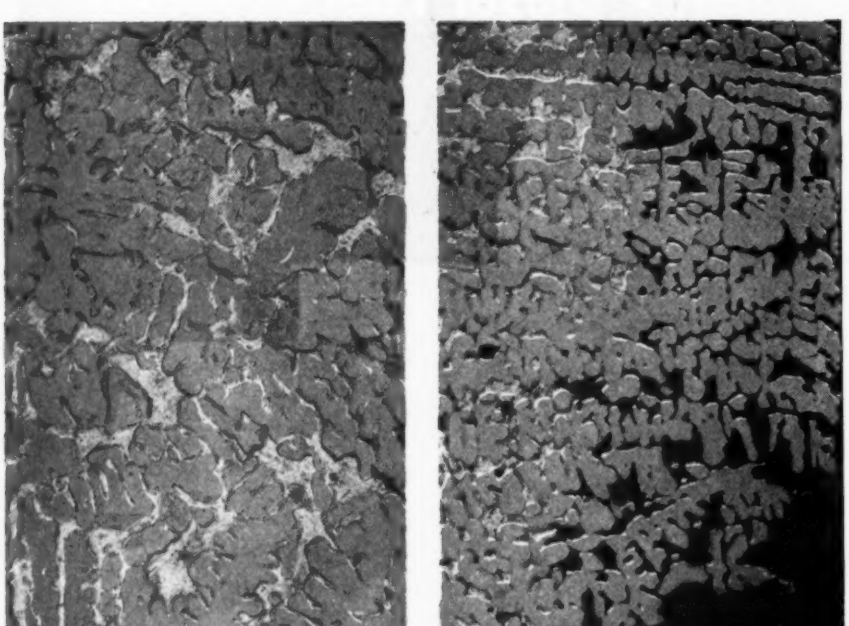
ESTABLISHED 1856

SUNNYVALE, CALIFORNIA

Branch Offices: WASHINGTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • NEW YORK • LOS ANGELES • DETROIT • PHILADELPHIA • PITTSBURGH • SAN FRANCISCO • BOSTON

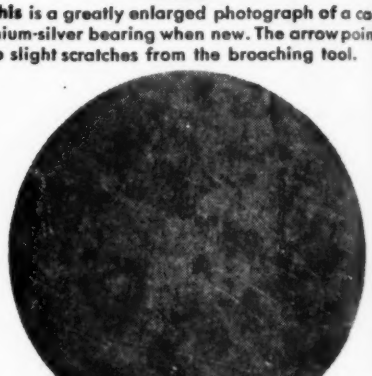
88-D-15

How RPM DELO Eliminates Diesel Bearing Corrosion

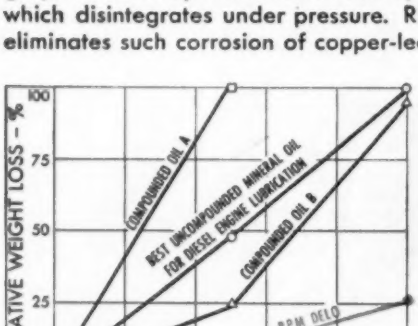


This is what happens to a copper-lead bearing when unstable lubricating oils that become corrosive, attack the lead. The picture on left shows a greatly enlarged cross-section of a new bearing, the copper in red, and lead in light grey. The picture on right shows the same type of bearing with the lead (light grey) eaten away from the surface by corrosion, leaving a copper honeycomb which disintegrates under pressure. RPM DELO Diesel Engine Lubricating Oil eliminates such corrosion of copper-lead or any kind of bearing.

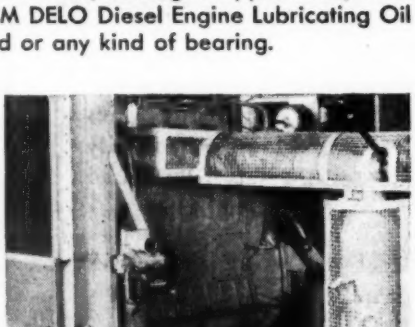
This is a greatly enlarged photograph of a cadmium-silver bearing when new. The arrow points to slight scratches from the broaching tool.



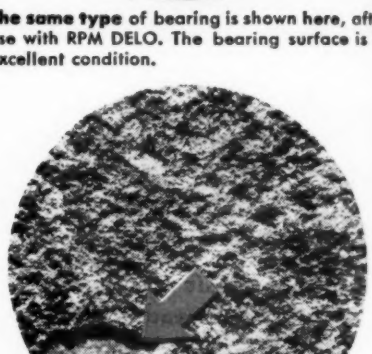
The same type of bearing is shown here, after use with RPM DELO. The bearing surface is in excellent condition.



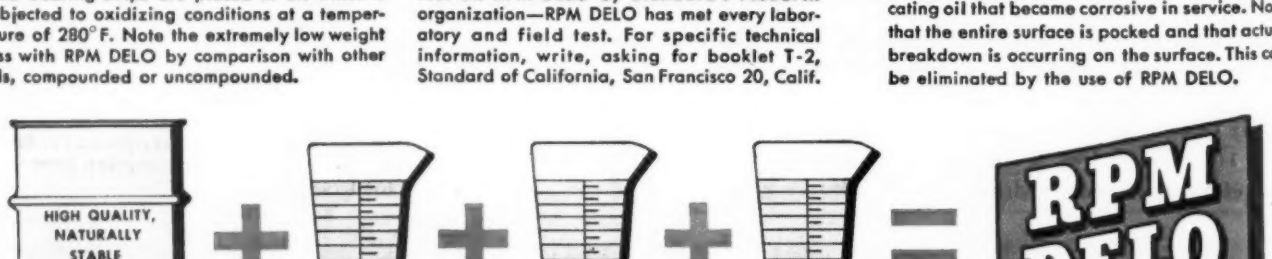
This chart shows what happens when copper-lead bearing strips are placed in oil which is subjected to oxidizing conditions at a temperature of 280° F. Note the extremely low weight loss with RPM DELO by comparison with other oils, compounded or uncompounded.



This photo shows equipment used in a 500-hour test on RPM DELO by Standard's research organization—RPM DELO has met every laboratory and field test. For specific technical information, write, asking for booklet T-2, Standard of California, San Francisco 20, Calif.



This bearing was used with an unstable lubricating oil that became corrosive in service. Note that the entire surface is pocked and that actual breakdown is occurring on the surface. This can be eliminated by the use of RPM DELO.



Detergent compound to clean engine.

Anti-oxidant to prevent gum and sludge.

Wear-reducing compound.

STANDARD OF CALIFORNIA

RPM DELO has world-wide distribution and is marketed under the following names: RPM DELO, Caltex RPM DELO, Kyso RPM DELO, Signal RPM DELO, Sohio RPM DELO, Imperial RPM DELO

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• BETTER PRESSURE PIPING

• This book . . . the revised Code for Pressure Piping . . . contains detailed information on selection of proper materials, dimensional standards, maximum allowable stresses . . . fabrication details such as welded joints, flanged joints, hangers, testing, welding procedure and operator qualification . . . more than 200 pages of useful and necessary information about piping.

Better pressure piping begins with the use of this Code—which is sponsored by the American Society of Mechanical Engineers and approved by the American Standards Association. If you make certain your piping conforms to the Code you may be sure it will not fall below the accepted standards of safety and good practice.

All qualified pipe fabricators comply with this Code. It is essential to the pre-fabrication of quality piping . . . piping that is economical and easy to install.

The Pipe Fabrication Institute will send this Code on request at the established price of $2.00 per copy.

P.F.I. THE PIPE FABRICATION INSTITUTE

G-8

THE PIPE FABRICATION INSTITUTE

Devoted to the Technical and Economic Problems in Piping

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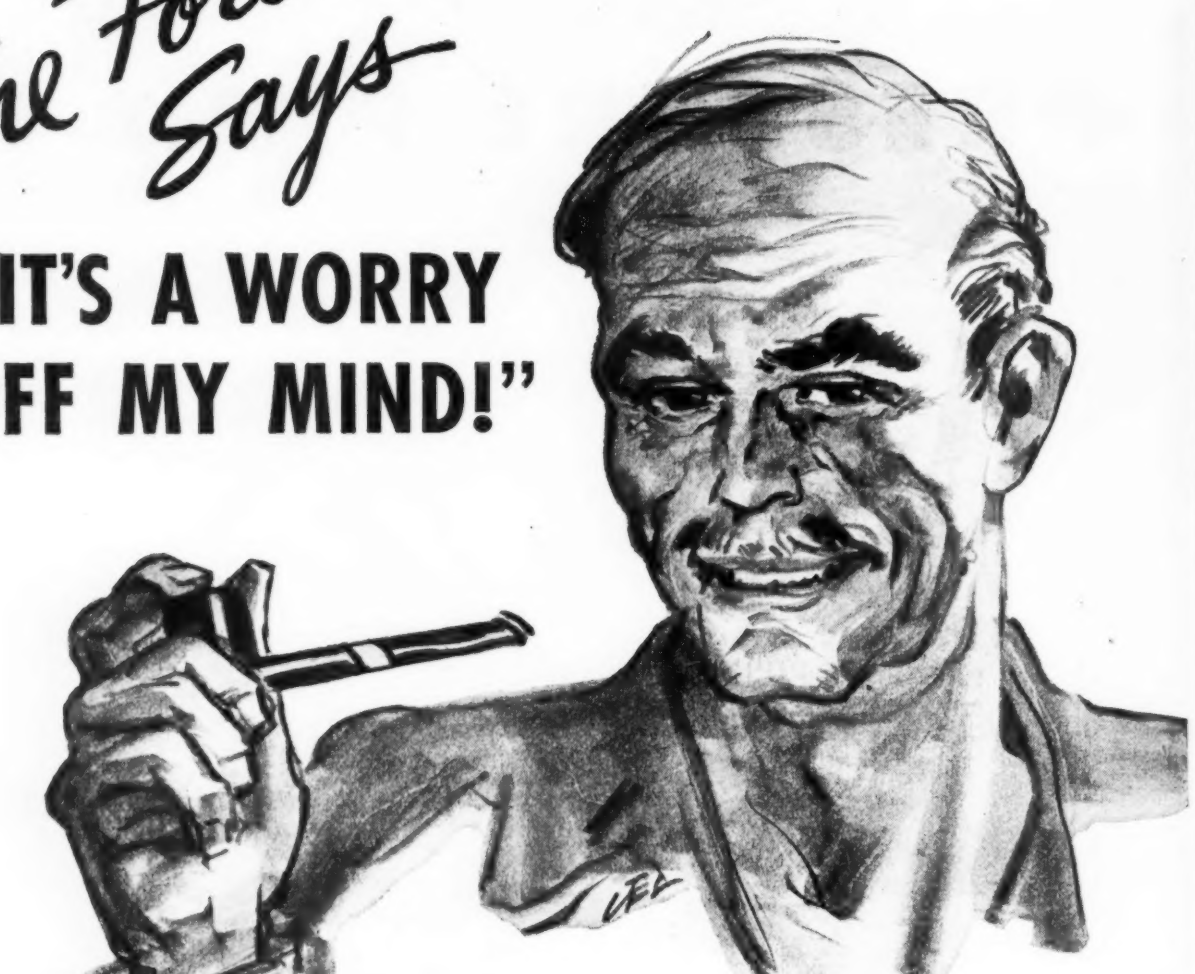
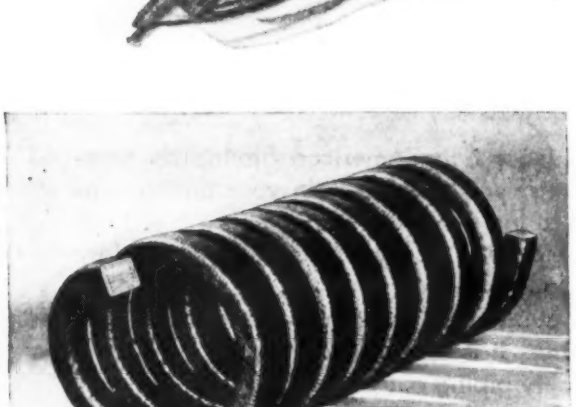
The Foreman Says

"IT'S A WORRY OFF MY MIND!"



"Now that we have standardized on GARLOCK Packings, Gaskets and KLOZURE Oil Seals, I can sleep nights! No more worries about interrupting essential production on account of frequent shut-downs for repacking, etc."

GARLOCK products give long, dependable service because they are manufactured in our own plant and are *quality-controlled* from raw material to finished product.

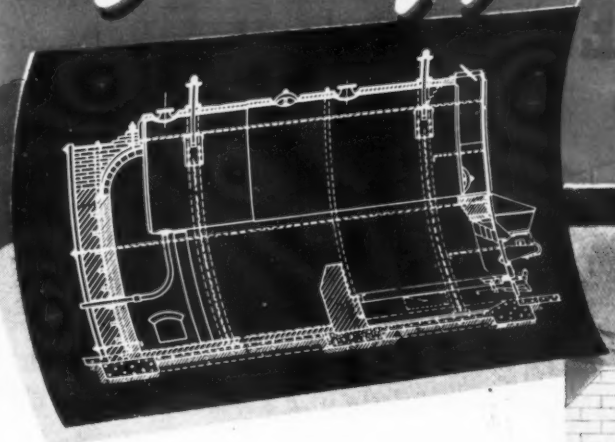


GARLOCK 150 High Pressure Steam Packing is one of the large number of GARLOCK *quality-controlled* products. Illustration shows spiral form (GARLOCK 150). Coil form—GARLOCK 125. Ring form—GARLOCK 200.

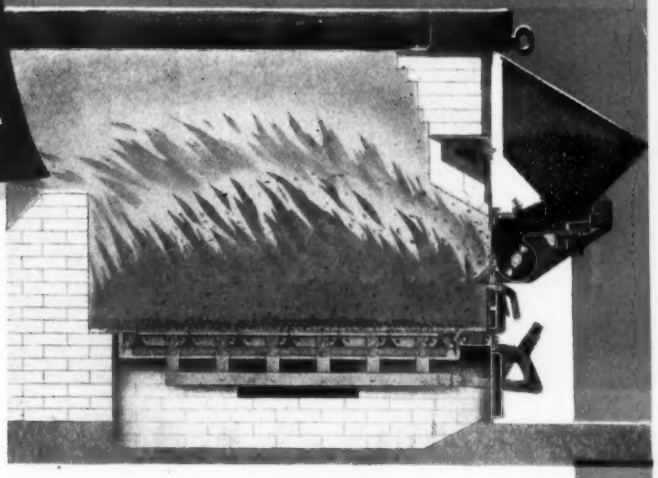
THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Limited, Montreal, Que.

Garlock

BROS speeds production of dairy products!



Creameries Install BROS Boilers and Stokers!



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BRIDGEMAN CREAMERIES
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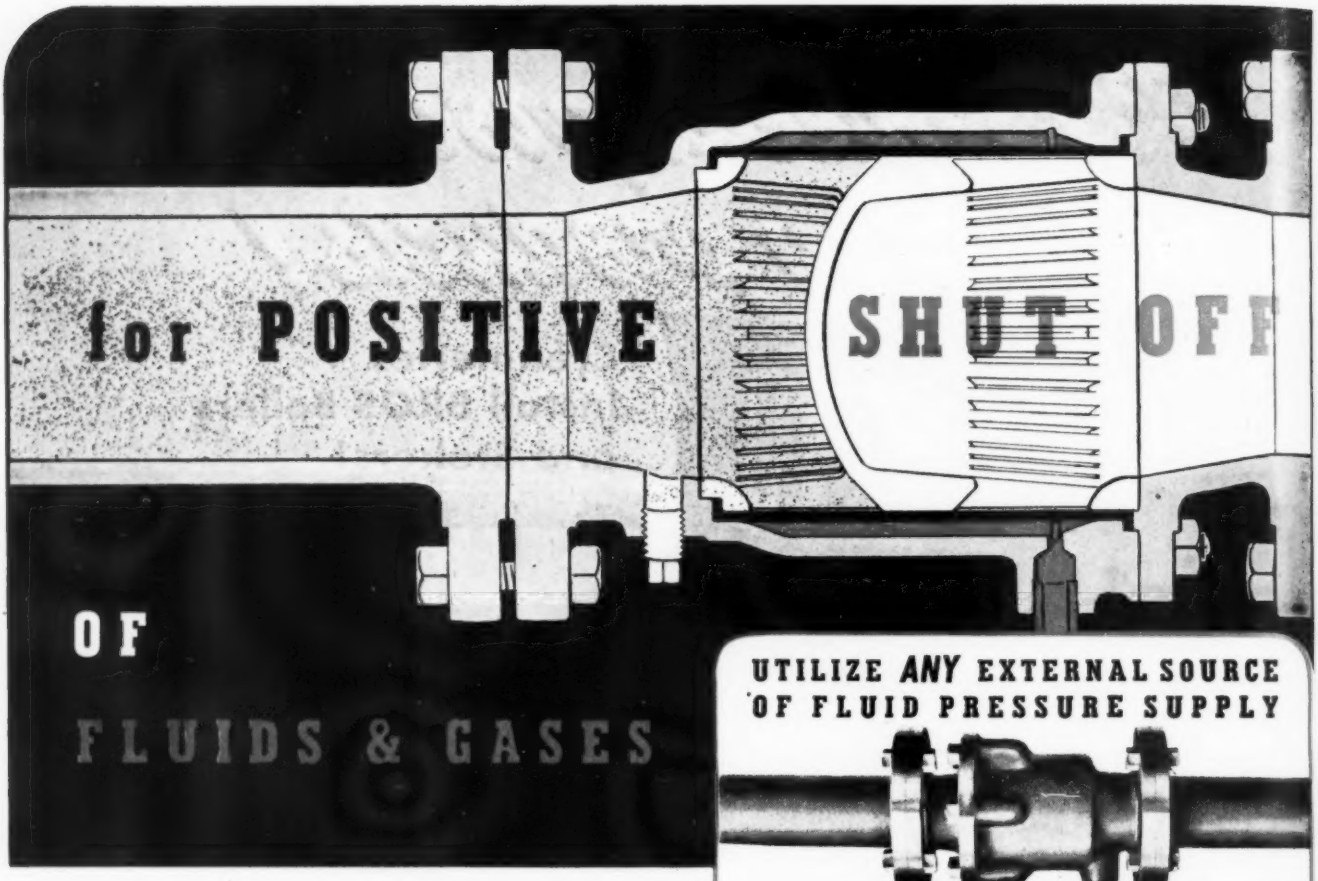
● The way our creameries are meeting the heavy demands for butter, evaporated, condensed and dried milk products is one of the bright spots in America's war-time production.

The processing of dairy products requires more steam than usual factory operations. To meet the demand for a constant supply, in vast quantities at low cost, Bros H.R.T. self-contained boiler units, equipped with Bros model 16 spreader stoker, were selected recently by outstanding creameries in the dairy section.

Bros brings to your steam generating problems, single responsibility from hopper to stack, plus 62 years of experience in engineering and manufacture. Bros offers competent counsel through accredited resident representatives and an eagerness to serve your interests that guarantees customer satisfaction. We'd like to hear from you about your boiler and stoker needs.

WM. BROS BOILER & MFG. CO.
Minneapolis 14, Minnesota

BROS Steam Generating EQUIPMENT



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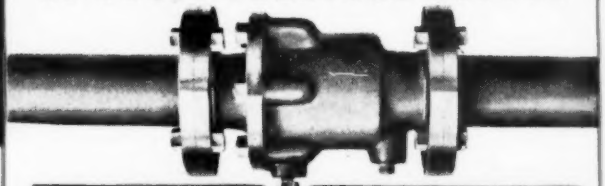
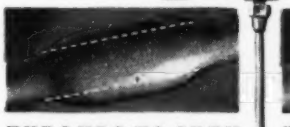
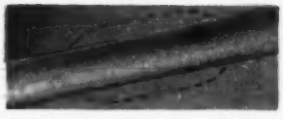
With no moving metallic parts employed in Grove FlexFlo Valves there is never any chance for hang-up, damage or leakage to occur from the transmission of fluids containing sand, cuttings, scale or other fine solid particles. Actuated by hydraulic pressure from any external source, the expansible synthetic tube which expands to open—contracts to close, seats tight for extended periods of time, with never any tendency to stick. Any abrasive wear is automatically compensated for by the contractile conformance of the flexible tube to even roughened or irregular seating surfaces. As this tube forms its own end-gaskets within the valve body, line fluid is completely isolated from the operating fluid medium at all times. For complete details write for Bulletin 800.

UTILIZE *ANY* EXTERNAL SOURCE OF FLUID PRESSURE SUPPLY





EXPANDS TO OPEN



CONTRACTS TO CLOSE

BY *Remote Control*

THE **ORIGINAL** EXPANSIBLE TUBE TYPE VALVE

A 1½" VALVE requires only a tablespoon of fluid for each operation.

A 4" VALVE uses barely a cup of fluid to operate.

AN 8" VALVE operates on less than a quart of fluid which can be piped back into the supply if necessary.

GROVE *FLEX-FLO* REMOTE CONTROL VALVES

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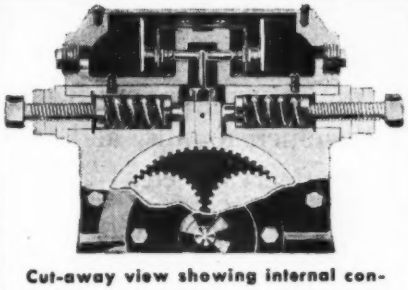

Cut-away view showing internal construction. PlaneTorque switch responds to overloads more quickly than electrical thermal relays since the mechanical action of the overload operates the cut-out switch directly.

Philadelphia PLANETORQUE-MOTOREDUCER

. . . a compact; self-contained unit that is particularly suited for driving stokers, conveyors, mixers and other equipment that may be subject to jamming or overloading. The MotoReduceR is efficient and dependable in service, truly economical in every way and in addition the PlaneTorque feature is always ready to protect the unit against the above mentioned emergencies. Whenever a predetermined load limit is exceeded, power is instantly and automatically shut off, preventing damage to either the drive or the driven equipment. Removal of the excess load makes the unit ready for service once more.

The PlaneTorque feature can be furnished on either vertical or horizontal types of MotoReducERs which are available in a wide range of horsepowers and ratios.

For full details write for Bulletin MR 40 on your business letterhead.

ARMY E NAVY

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GEAR WORKS INCORPORATED

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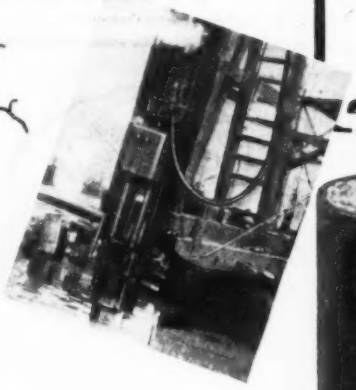
Industrial Gears and Speed Reducers
LimiTorque Valve Controls

Republic Steam Hose

Designed and Reinforced for *Pressures* and *Temperatures*



REPUBLIC technologists have studied the effects of continued high steam pressure and temperature on hose structures. Through this research, a complete line—Republic Double Cross, Tower, Hector, and Republic Asbestos Hose—is constructed and reinforced to meet all service conditions. Each type and each size is designed with an unusually high safety factor and tested for burst strength as well as for working pressure. Tell your Republic Distributor your requirements—flue cleaning, thawing, pile driving, steam hammer, foundry and steam engine service, etc.—and he will recommend a Republic Steam Hose designed for that service.

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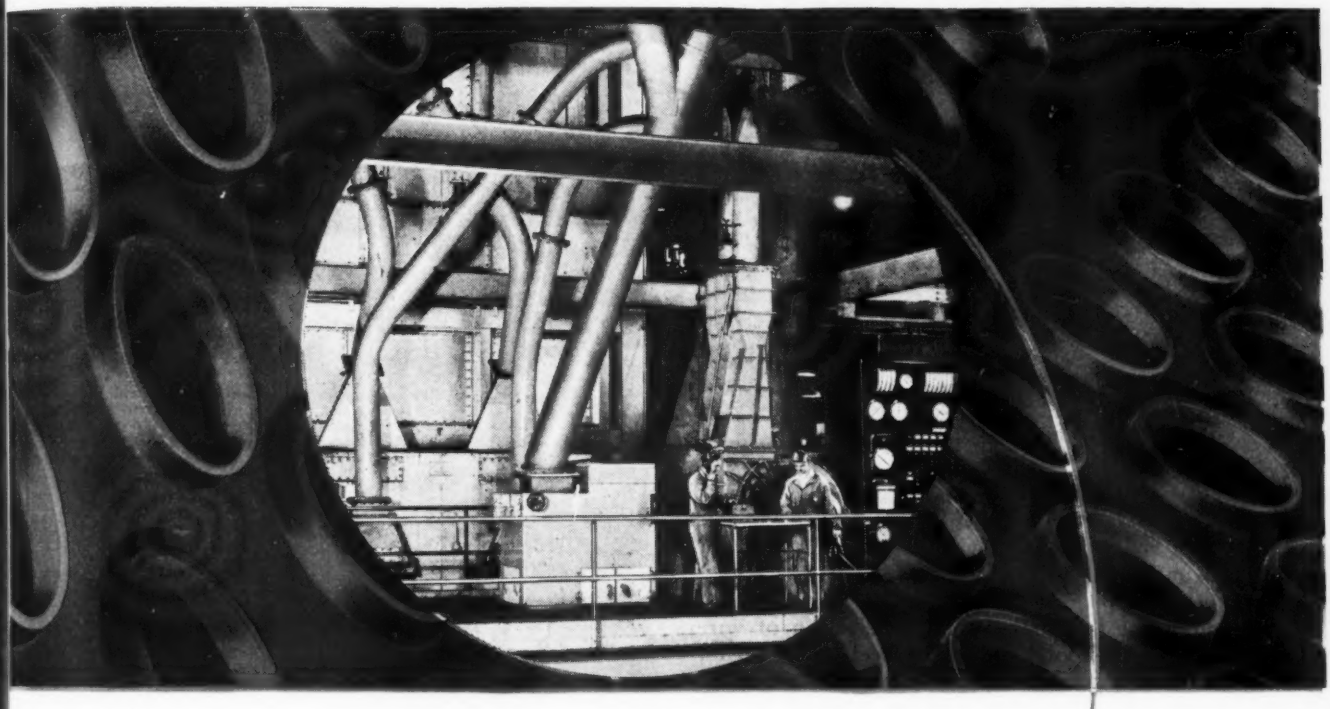
CHEMICAL SCALE REMOVAL SERVICE



DISSOLVES, DISINTEGRATES AND REMOVES

THE THIEVES OF POWER

Safely, thoroughly—with speed—the heat exchange surfaces of American industrial plants are freed of their power-stealing water- and steam-deposited scale, sludge and oxides by Dowell chemical methods.

A minimum of down-time is required for this important work—usually only a few hours—and there is no extensive dismantling of equipment.

Inhibited solvents, prepared for the particular job, dissolve and disintegrate the deposits without damage to the equipment.

Dowell Chemical Cleaning is another important cooperative development—the result of Dowell chemical and engineering techniques together with the research and technical facilities of its parent organization, The Dow Chemical Company.

Fully mobile equipment manned by trained engineers is on call from many strategic points in the United States. Write, wire or phone the most convenient Dowell office.

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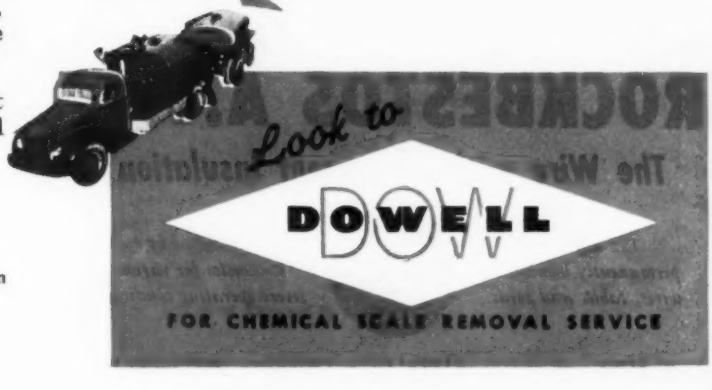
Service from Long Beach and Casper provided by a Dowell associated company, International Cementers, Inc.



Slit It Open and SEE the Difference

Two important factors govern the selection of wire and cable for "hot-spot" service in steel mills, power plants and various vital industries. First, the conditions under which the circuits must operate, such as around soaking pits, boilers, furnaces, steam lines, drying ovens, rheostat grids; places where resistance to heat and moisture, corrosive fumes, oil, grease and even fire is essential. Second, and most important, is the construction of the wire—its in-built ability to stand up under these severe conditions.

Rockbestos A.V.C. Power, Motor Lead and Lighting Wires and Cables (National Electrical Code, Type AVA) meet the requirements of "hot-spot" service with permanent insulation that won't bake brittle, crack, bloom, swell or rot and has a maximum operating temperature rating of 110° C. (230° F.).

Apply the knife-test to a sample of Rockbestos A.V.C. and you'll find the answer to production losses and unnecessary maintenance due to wire-failure beneath the braid. Send for a sample and dissect it yourself. Rockbestos Products Corporation, 983 Nicoll St., New Haven, Conn.

ROCKBESTOS A.V.C.

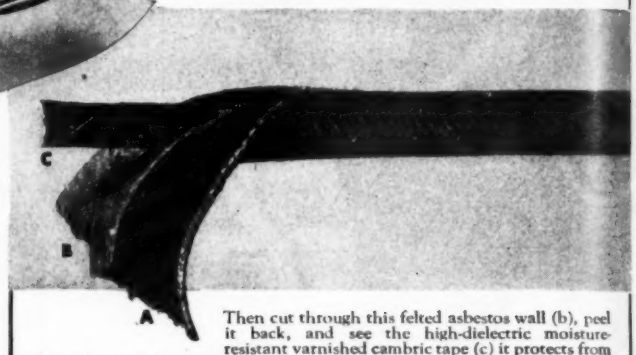
The Wire with Permanent Insulation

122 different permanently insulated wires, cables and cords

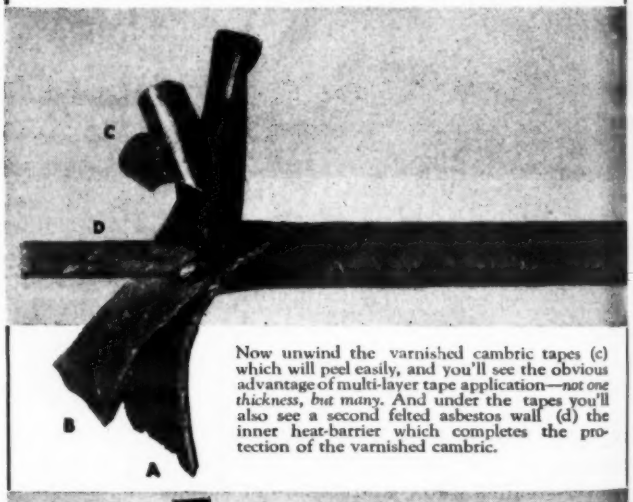
ROCKBESTOS

developed by Rockbestos for various severe operating conditions

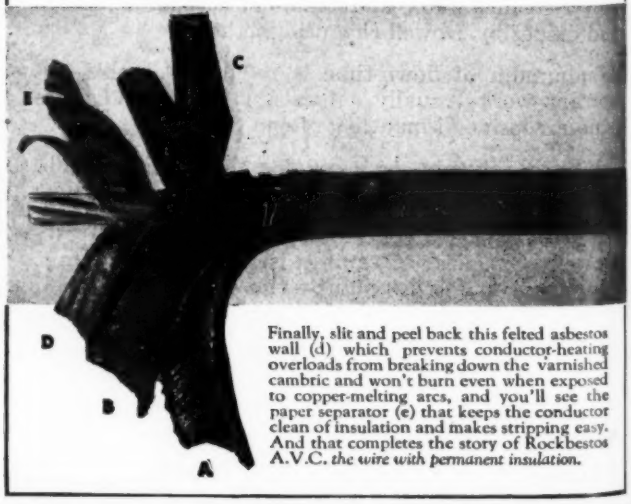
Take a sample of Rockbestos A.V.C. Power Cable, illustrated, or similarly insulated Motor Lead Cable, slit open the slick-finished heavy, heatproof, fireproof asbestos braid (a) which is resistant to moisture, oil and grease, and you'll find beneath a firewall of felted asbestos (b) a permanent heat-barrier against high ambient temperatures.



Then cut through this felted asbestos wall (b), peel it back, and see the high-dielectric moisture-resistant varnished cambric tape (c) it protects from heat, flame and oxidation. Notice too, the uniform coverage of the tapes, helically applied like the felted asbestos to assure perfect and permanent centering of the conductor in the insulation.

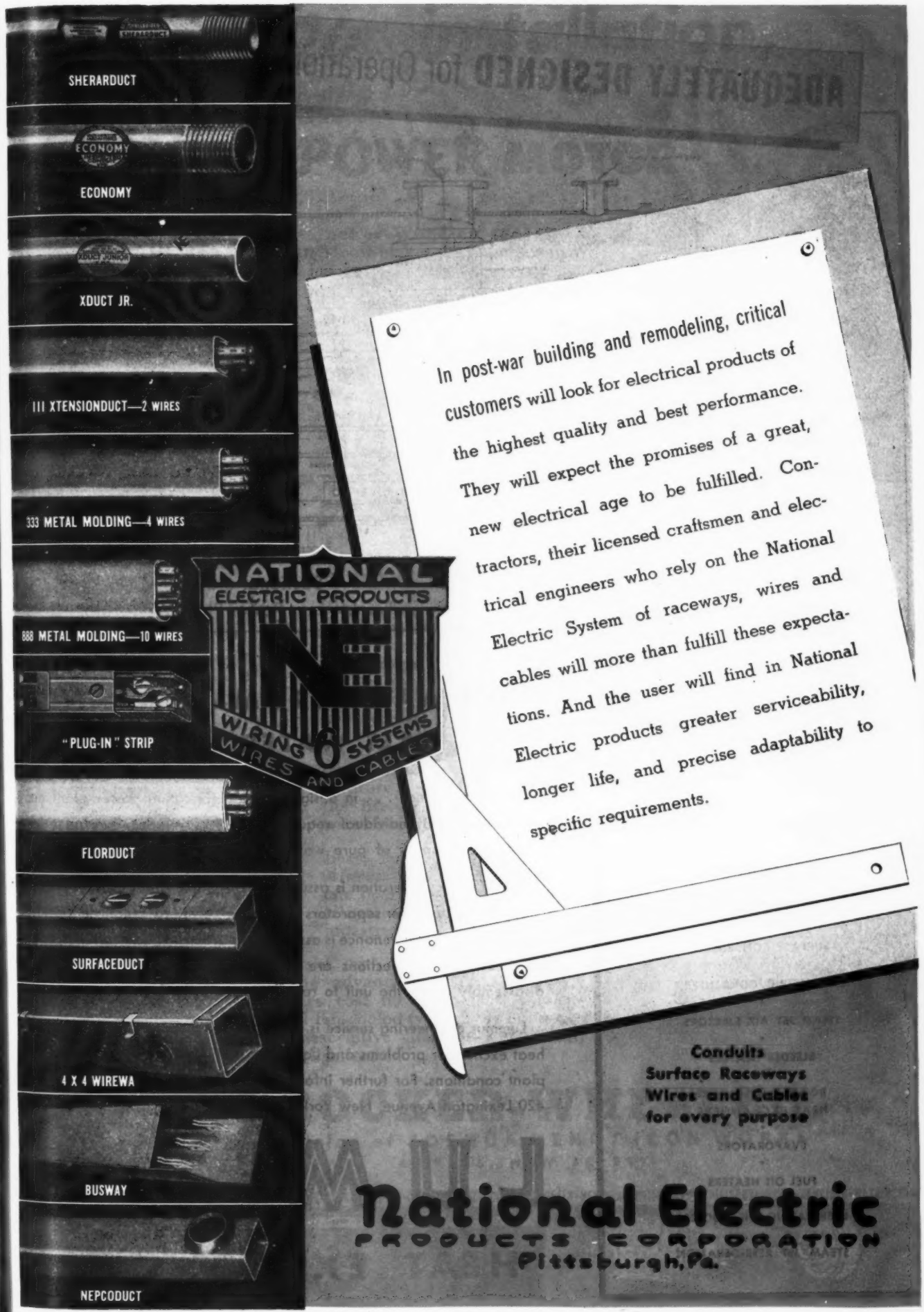


Now unwind the varnished cambric tapes (c) which will peel easily, and you'll see the obvious advantage of multi-layer tape application—*not one thickness, but many.* And under the tapes you'll also see a second felted asbestos wall (d) the inner heat-barrier which completes the protection of the varnished cambric.



Finally, slit and peel back this felted asbestos wall (d) which prevents conductor-heating overloads from breaking down the varnished cambric and won't burn even when exposed to copper-melting arcs, and you'll see the paper separator (e) that keeps the conductor clean of insulation and makes stripping easy. And that completes the story of Rockbestos A.V.C. *the wire with permanent insulation.*

NEW YORK, BUFFALO, CLEVELAND, CHICAGO, PITTSBURGH, ST. LOUIS, LOS ANGELES, SAN FRANCISCO, SEATTLE, PORTLAND, ORE.


SHERARDUCT
ECONOMY
XDUCT JR.
111 XTENSIONDUCT—2 WIRES
333 METAL MOLDING—4 WIRES
888 METAL MOLDING—10 WIRES
"PLUG-IN" STRIP
FLORDUCT
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In post-war building and remodeling, critical customers will look for electrical products of the highest quality and best performance. They will expect the promises of a great, new electrical age to be fulfilled. Contractors, their licensed craftsmen and electrical engineers who rely on the National Electric System of raceways, wires and cables will more than fulfill these expectations. And the user will find in National Electric products greater serviceability, longer life, and precise adaptability to specific requirements.
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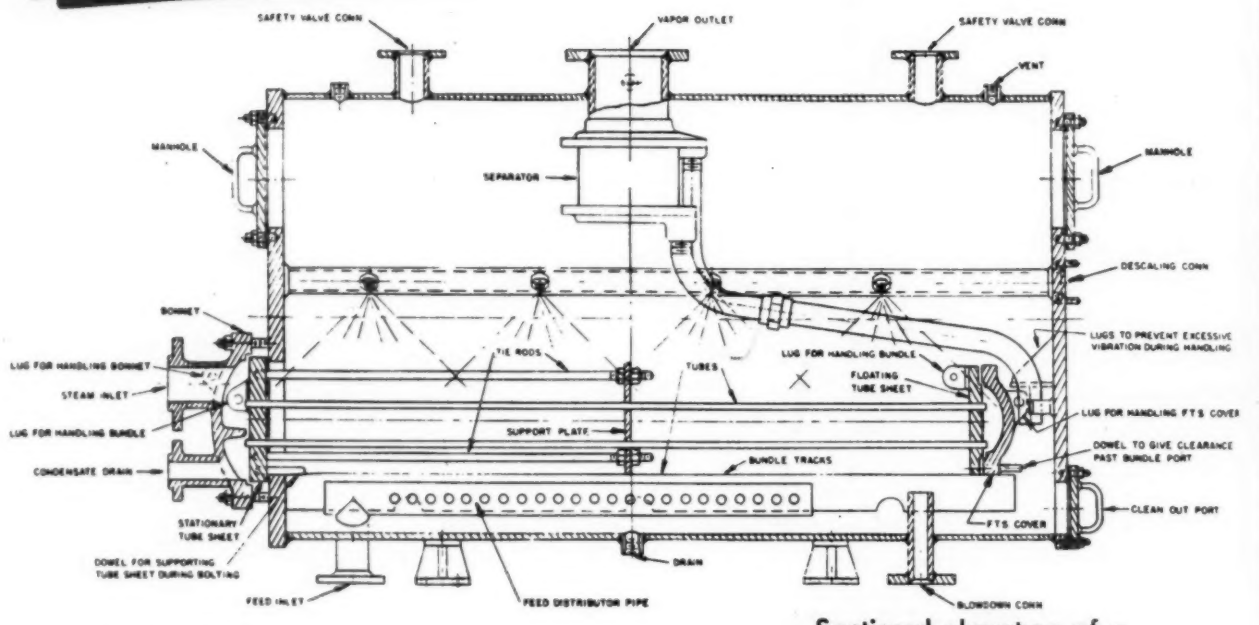
Surface Raceways
Wires and Cables
for every purpose
National Electric
PRODUCTS CORPORATION
Pittsburgh, Pa.

ADEQUATELY DESIGNED for Operation and Maintenance



Sectional elevation of a
Lummus Power Plant Evaporator

PURE WATER FROM ANY RAW OR SALT WATER SUPPLY

Lummus experience . . . in designing and fabricating power plant evaporators to meet individual requirements . . . is your guarantee of a dependable supply of pure water from any raw or salt water source.

Full-efficiency operation is assured by a soundly based design that provides adequate vapor separators and liberal, properly balanced disengaging areas. Easy maintenance is assured by a practical understanding of field conditions. All connections are readily accessible and do not require disassembly within the unit to remove the tube bundle.

Lummus engineering service is always available for the study of specific heat exchanger problems and equipment design to meet individual power plant conditions. For further information write to: The Lummus Company, 420 Lexington Avenue, New York 17, N. Y.

LUMMUS EQUIPMENT

SURFACE CONDENSERS
•
BAROMETRIC CONDENSERS
•
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•
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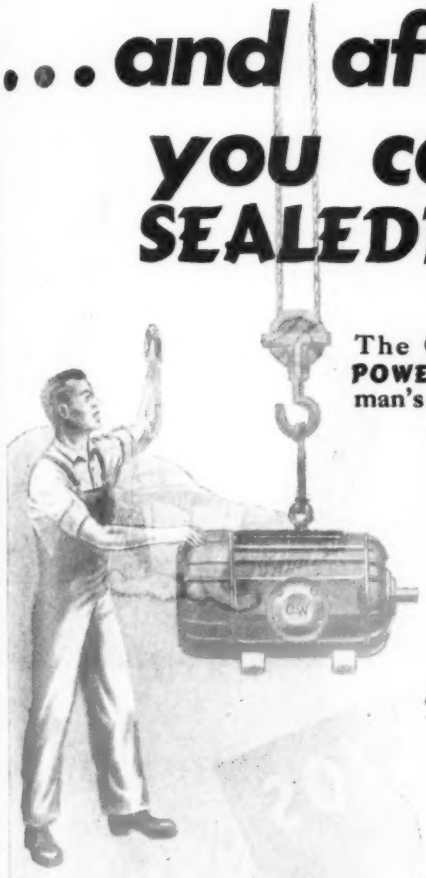
FUEL OIL HEATERS
•
LUBRICATING OIL COOLERS
•
STEAM JET REFRIGERATION

LUMMUS

HEAT EXCHANGERS

...and after installation, you can forget a SEALEDPOWER MOTOR



The Crocker-Wheeler **SEALED-POWER** Motor makes the maintenance man's job easy. Here's why:

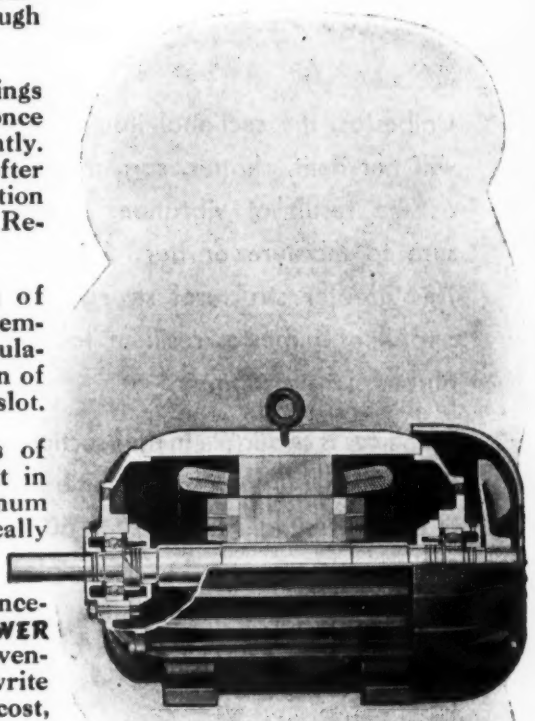
1 The totally-enclosed frame seals out harmful foreign matter. There is no danger of oil, corrosive liquids, acid or alkali fumes, air-borne moisture, steam, conducting dusts or metal chips, for example, causing premature breakdown of windings.

2 There are no ventilating passages in the frame to require periodic cleaning. Cooling air is blown over the outside surfaces of the motors, not through the frame.

3 Patented *Grooveseal* bearings require re-greasing only once a year or even less frequently. Seal permits use of softer grease, for better lubrication and longer bearing life. Retains grease.

4 Vacuum impregnation of windings reduces hotspot temperature and lengthens insulation life. Prevents vibration of wires inside or outside of slot.

5 Bars, fans and end rings of *Alucast* rotor are die cast in one operation from aluminum alloys, forming a practically indestructible rotor.



And yet, with all these maintenance-cutting advantages, **SEALEDPOWER** Motors cost no more than conventional fan-cooled types. Why not write for descriptive literature? No cost, no obligation.

CROCKER-WHEELER

A Division of JOSHUA HENDY IRON WORKS

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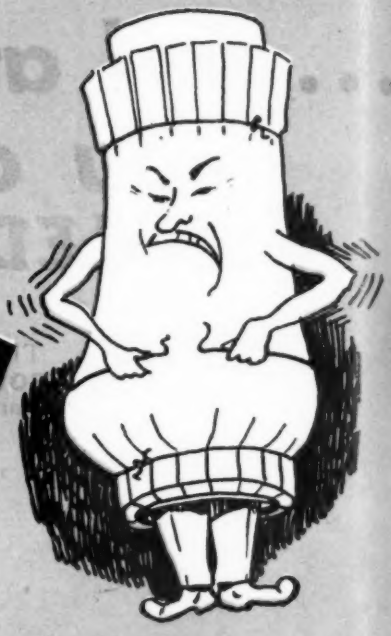
SQUIRREL CAGE MOTORS | WOUND ROTOR MOTORS | DIRECT CURRENT MOTORS | GENERATORS | FLEXIBLE COUPLINGS

TROUBLED BY "MIDDLE-AGE SPREAD"?

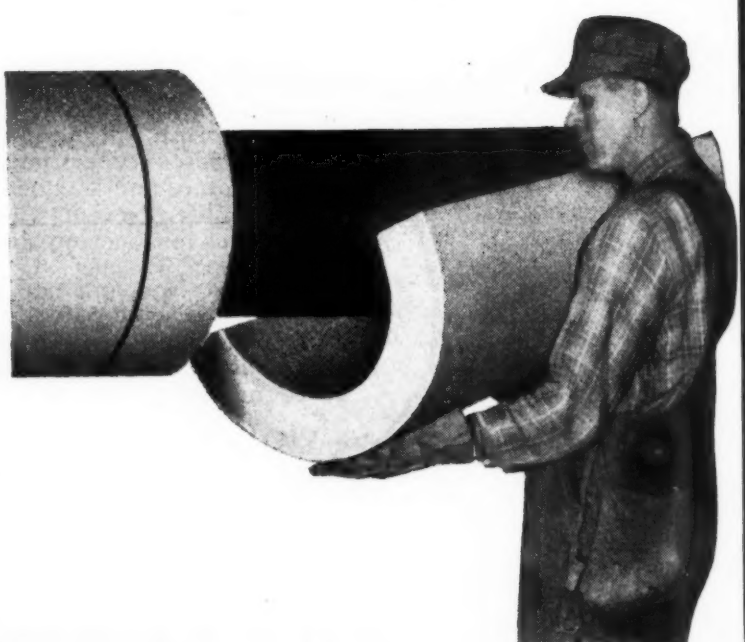


SIMPLY APPLY UNIBESTOS

it's simple to apply!

Unibestos, the sectional insulation, will not dent, shatter, sag or gap as the result of vibration, exposure to moisture or hard knocks. This greater structural strength is a result of Unibestos' resilient, tough fibrous construction.

Unibestos is available in half-section form up to 30" pipe diameter and in quarter sections from 32" to 60", in thicknesses from ¾" to 5". Single layer construction is available for service up to 1200°.



ARMY NAVY E

UNION ASBESTOS

MEANS PROGRESS IN INSULATION

AND RUBBER CO.

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UNION ASBESTOS AND RUBBER CO.

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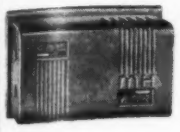
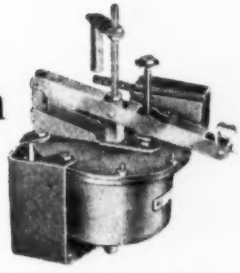
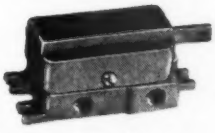
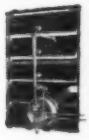


REMEMBER the Gradutrol System



of Pneumatic Control? Sure you do!

. . . But do you remember the important part the Gradutrol Relay  plays?

It produces precision control with positive positioning  of dampers or valves, and full modulation. Top power in either direction is available to overcome friction, but air consumption is reduced to a minimum . . .

Don't overlook the many important advantages of Gradutrol in those critical air conditioning process installations . . . Even the simplest job deserves Gradutrol. The added cost is negligible . . .

MINNEAPOLIS-HONEYWELL REGULATOR CO., 2702 Fourth Ave. S., Minneapolis 8, Minn. • Branches in all principal cities

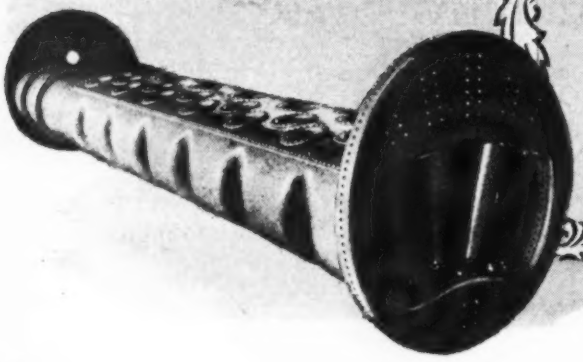
Keep them Winning —
Buy MORE War Bonds!

MINNEAPOLIS
Honeywell
CONTROL SYSTEMS

Since 1878 . . .

Steam Generating Equipment

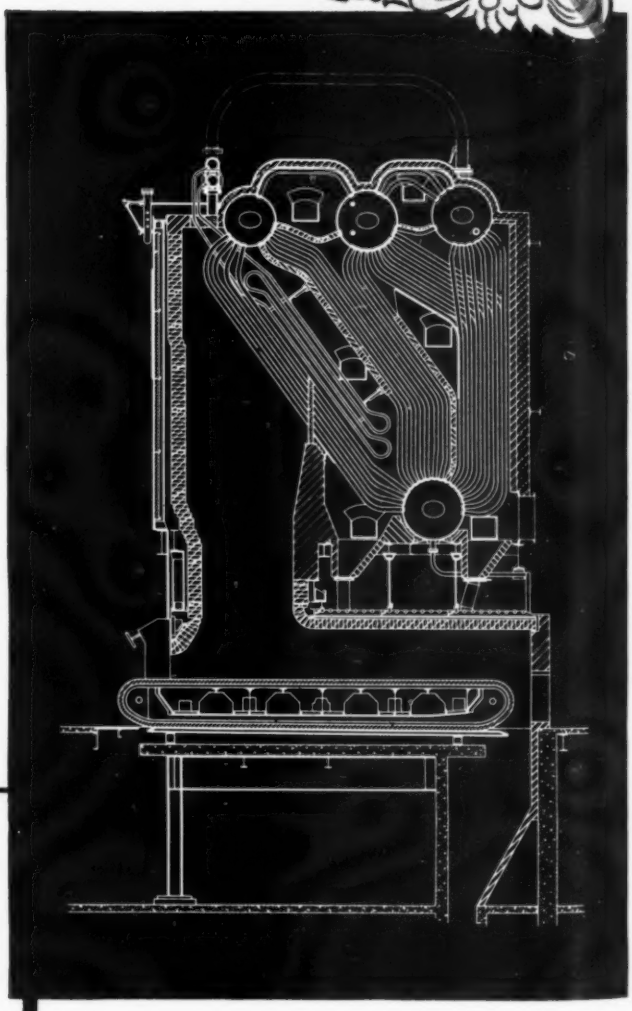
by EDGE MOOR



How many power engineers can identify the illustration at the left? It is the internal flue of an "Improved Galloway Boiler," an outstanding type in its day. Edge Moor began building Galloway boilers in 1878—and have been engaged in designing, developing and building steam generating equipment ever since.

Back of every Edge Moor installation of today there is the wealth of experience acquired through 67 years of boiler building—a cumulation of skills, methods and knowledge that enables Edge Moor to build boilers as outstanding in performance as were the Galloways in the days of the previous century.

Edge Moor boilers are designed for any required capacity and up to 900 lbs. drum pressure. Complete steam generating units, auxiliary equipment and installation service are available including boilers, superheaters, water walls, economizers and air preheaters. The combination of Edge Moor engineering experience and manufacturing control assures the ultimate in power plant performance.



Edge Moor bent tube boiler with pendant interbank superheater and travelling grate stoker. Capacity 47,500 lbs. steam per hour; Drum Pressure, 275 psi; Degrees of Superheat, 180° F.; Final Steam Temperature, 585° F.

STEAM GENERATING EQUIPMENT

BRANCH OFFICES: NEW YORK 20, N. Y.: 30 ROCKEFELLER PLAZA
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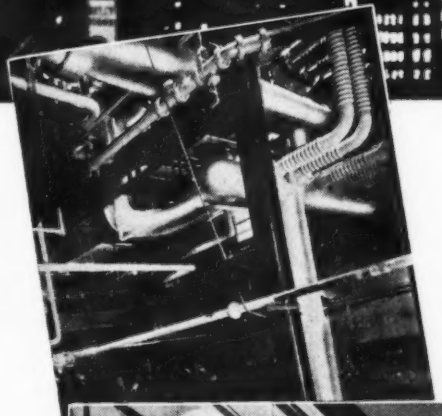
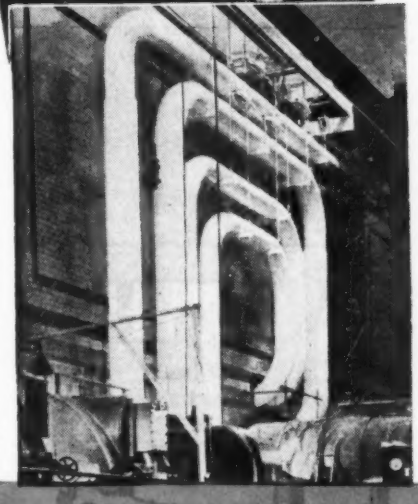
EDGE MOOR
IRON WORKS, INC.

MAIN OFFICE AND WORKS: EDGE MOOR, DELAWARE





THE Kellogg Scientific Method of solving tough piping problems has enabled central stations, process and marine power plants to successfully meet wartime emergency needs.

Kellogg prefabricated piping systems simplify piping problems because they conserve space—minimize joint stresses—provide safe connections to equipment unable to stand high forces or moments due to expansion—and give flexibility and complete reliability.

Consulting engineers, power process and marine engineers recognize the Kellogg trade mark as a symbol of scientifically designed piping.

KELLOGG

"Masterflex" Prefabricated Piping Systems · "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Hydroforming, Refining, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units · JUKI Processes for Lubricating Oil Plants. Plastic Refractories · Radial Brick Chimneys.

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FLEXTOOTH
(PATENTED)
CRUSHER

ADJUSTABLE FOR ANY SIZE PRODUCT from 2" to ¼"

EITHER HIGH OR LOW PERCENTAGE OF FINES

Reduces run-of-mine coal to required product with either a minimum or high percentage of fines. Centrifugal force holds teeth in crushing position but permits them to swing back when in contact with tramp iron. Made in ten sizes. Catalog No. 706.

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a NEW *Industrial* POWER TUBE *by* Federal

TECHNICAL DATA FOR TYPE F-5303

Filament Voltage	11.0 volts
Filament Current	27.5 amps.
Maximum Ratings for Maximum Frequency of 50 Mcs.	
DC Plate Voltage	3500. volts
DC Plate Current	1.0 amp.
Plate Dissipation	1200 watts
Overall Height	app. 7"
Maximum Diameter	3½"
Supplied with 6" flexible copper leads, 2 on each terminal.	
Type of Cooling	Forced-air
(Also supplied for water-cooling, type F-5302.)	

Federal presents a new and rugged power tube that fills an immediate demand — a power tube that has been *specially* designed for industrial use in high-frequency heating equipment, both dielectric and induction.

Really built to withstand the constant jars, shocks, and vibration commonly encountered in manufacturing operations, this heavy-duty vacuum tube is very conservatively rated, and will stand up under extremely hard usage.

Widely spaced, unusually sturdy filament and grid elements, without internal ceramic insulation, give this tube a ruggedness that makes it the logical choice for dependability in the design of industrial heating equipment.

For industrial power tubes, and also for rectifier and transmitting tubes, see Federal first... because "Federal always *has* made better tubes."

FEDERAL TELEPHONE & RADIO FTR

Federal Telephone and Radio Corporation

An IT&T Associate

Newark 1, New Jersey

Flush Valve Application Data

INDUSTRIAL PLANTS

Compiled by the manufacturers of Watrous Flush Valves

Architects Indicate Preferences in Poll on Flush Valves for Industrial Plants

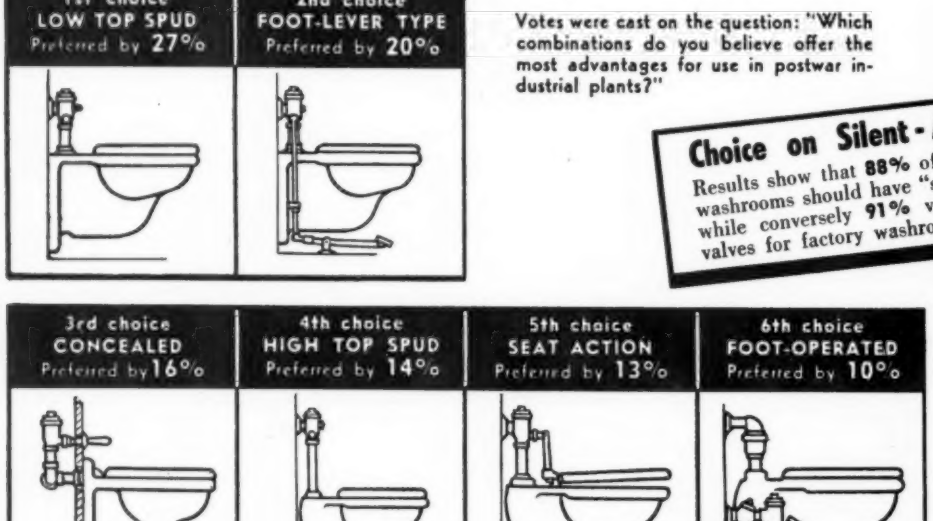
To obtain a reliable answer to the question, "What are the most suitable types of flush valves for industrial plants?", Watrous recently sent a special ballot sheet to a list of architects. Replies came from architects who do a tremendous amount of industrial plant designing.

This study, we believe, will be of considerable value in connection with present postwar planning. If you have any further thoughts on this subject, we shall be pleased to hear from you and to add your selections to the results summarized below.

Flush Valve Combinations for Closet Bowls

Votes were cast on the question: "Which combinations do you believe offer the most advantages for use in postwar industrial plants?"

1st choice	2nd choice	3rd choice	4th choice	5th choice	6th choice
LOW TOP SPUD	FOOT-LEVER TYPE	CONCEALED	HIGH TOP SPUD	SEAT ACTION	FOOT-OPERATED
Preferred by 27%	Preferred by 20%	Preferred by 16%	Preferred by 14%	Preferred by 13%	Preferred by 10%

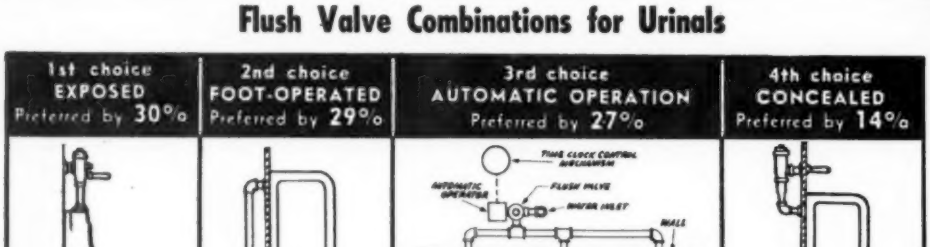


Choice on Silent-Action Combinations

Results show that **88%** of architects agreed that office washrooms should have "silent-action" flush valves . . . while conversely **91%** voted for the "regular" flush valves for factory washrooms.

Flush Valve Combinations for Urinals

1st choice	2nd choice	3rd choice	4th choice
EXPOSED	FOOT-OPERATED	AUTOMATIC OPERATION	CONCEALED
Preferred by 30%	Preferred by 29%	Preferred by 27%	Preferred by 14%

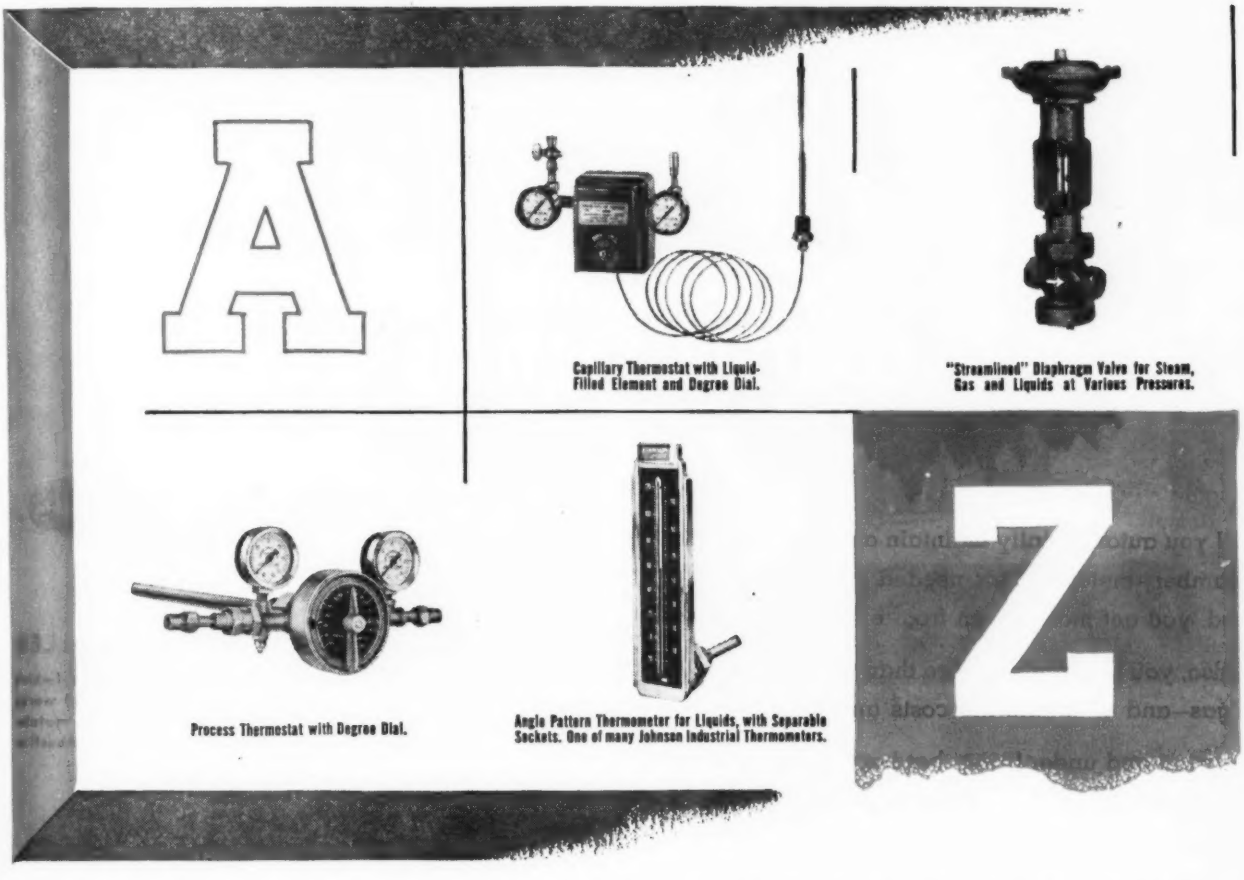


Catalog 448-A covers Watrous Flush Valves for essential wartime applications and the complete line of models and combinations for postwar planning. Or see Sweet's Catalog File.

THE IMPERIAL BRASS MFG. COMPANY, 514 South Racine Ave., Chicago 7, Illinois

Watrous Flush Valves

A COMPLETE SERVICE — TEMPERATURE CONTROL PROBLEMS SOLVED FROM A TO Z


A
Capillary Thermostat with Liquid-Filled Element and Degree Dial.
"Streamlined" Diaphragm Valve for Steam, Gas and Liquids at Various Pressures.
Process Thermostat with Degree Dial.
Angle Pattern Thermometer for Liquids, with Separable Sockets. One of many Johnson Industrial Thermometers.
Z

For trouble-free, efficient, economical operation of a heating plant, good temperature control equipment *alone* is not enough. That is why Johnson (established in 1885) renders a complete service from the planning stage through proper performance.

Johnson not only manufactures a complete line of precision-built thermostats and controllers but designs the whole temperature control system from "A to Z" in cooperation with owners and their consulting engineers. Then Johnson follows through by installing the system and getting it in perfect operating order before it is turned over to the plant engineer. Years of careful training and experience enable Johnson temperature control experts to bring seasoned knowledge to bear on the proper application of every element in a complete temperature control system.

On *your* next temperature control problem, whether heating, cooling, ventilating, air conditioning or industrial processing, ask your heating or air conditioning contractor about Johnson . . . or call a Johnson engineer from a nearby branch office. He is at your service, without obligation.

JOHNSON

Fuel-Saving Starts With CONTROL

Automatic TEMPERATURE AND AIR CONDITIONING Control

JOHNSON SERVICE COMPANY, MILWAUKEE 2, WISCONSIN • DIRECT BRANCHES IN ALL PRINCIPAL CITIES

THIS CONSTANT AUTOMATIC ATTENTION

The Answer

TO INCREASED BOILER CAPACITY...

CASH STANDARD

AUTOMATIC COMBUSTION CONTROL SYSTEMS

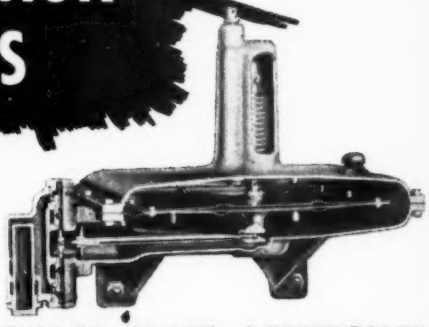
WHEN you automatically maintain a constant draft in the combustion chamber—meter the air needed for combustion and regulate fuel feed, you get more steam from existing equipment.

But, also, you accomplish more than that—you use less fuel—coal, oil, or gas—and eliminate the costs and error of human attention.

Over-firing and under-firing that happens without automatic control results in wasted fuel. With automatic control you adjust the rate of fuel feed exactly to the load requirements at all times. Thus, steam pressures are held within very close limits.

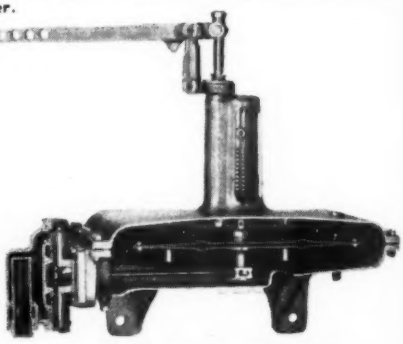
The three units shown are available in a number of variations. Therefore, selection of a CASH STANDARD Control System to meet any condition and dependably work on any system is easily accomplished.

If you will write for Bulletin 300 you will get the complete story of CASH STANDARD Automatic Combustion Control and see exactly how it works daily to your benefit.



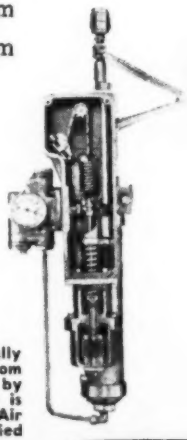
FURNACE DRAFT CONTROLLER

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.



AIR FLOW CONTROLLER

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.



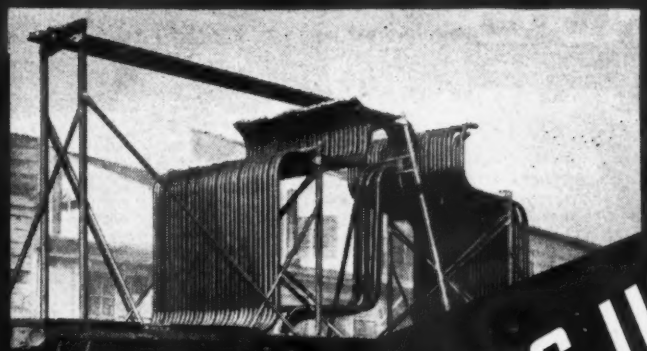
FUEL FEED CONTROLLER

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion—hence, money saving.

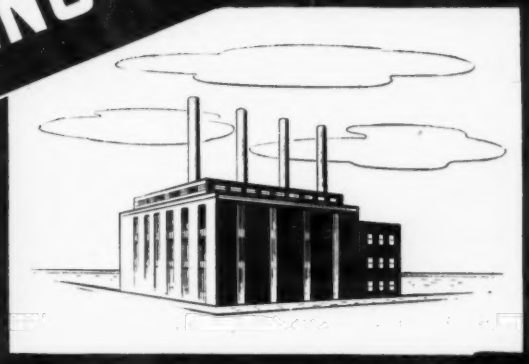
A. W. CASH COMPANY

DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES



Both are STEPPING UP statistics



● In 1944, the output of public utilities and industrial power plants hit a new all-time high. So did demands for B&W pressure tubing—both seamless and welded—for all kinds of steam generating and heat transfer equipment. For example, shipments of B&W *welded* pressure tubing alone *were over 100 per cent higher* than in 1943. Altogether, over 700,000,000 feet of both kinds have been installed in all types of boilers, heat exchangers, condensers, evaporators and other heat transfer equipment.

This growing and steadily increasing preference for B&W pressure tubes is an indication of their all-round satisfaction and reliability. It reflects their consistently uniform quality, dimensional accuracy and, above all, the enviable record of safety and service they are giving under a wide range of operating conditions involving temperatures up to 1500 degrees F. and pressures as high as 4500 psi.

Because B&W makes BOTH Seamless and Welded Tubes, you can depend on getting unbiased recommendations—tubes matched to jobs without prejudice toward any types or materials—when you call on B&W's wealth of tubing experience, modern specialty tube mills and extensive research facilities.

B&W TUBES

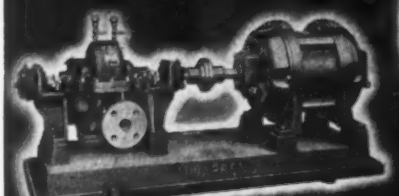
SEAMLESS. Complete range of carbon, alloy and Stainless steels. Sizes ½ in. to 8⅝ in. O.D.
ELECTRIC-RESISTANCE WELDED Carbon steel grades. Sizes: ¾ in. to 4 in. O.D.

THE BABCOCK & WILCOX TUBE CO.

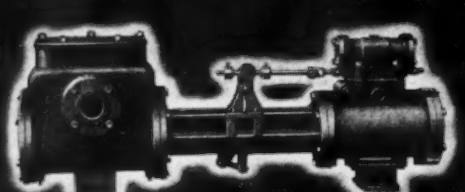
Welded Tube Division, Alliance, Ohio
Seamless Tube Division, Beaver Falls, Pa.

B&W MAKES BOTH

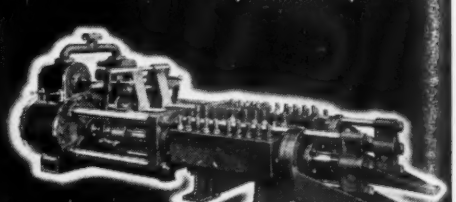
TT87



Warren Two-Stage Volute Centrifugal Pump



Warren Steam Heat Vacuum Pump



Warren Horizontal Duplex Hydraulic Pump

WARREN PUMPS

for Post-War Planning Include:

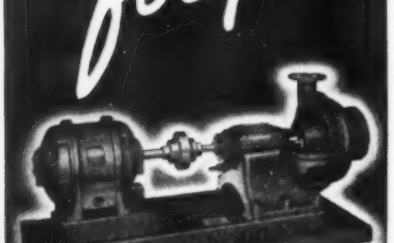
CENTRIFUGAL

Single and multi-stage
Pressure range: 0 to 850 P. S. I.
Capacities: 0 to 36,000 G. P. M.
Types: Horizontal & Vertical
Impellers: Open or enclosed
Casings: Horizontal or Vertical Split, cast iron or bronze
Bearings: Sleeve or ball-bearing

RECIPROCATING

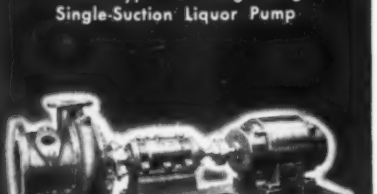
Horizontal and Vertical single piston
Horizontal and Vertical duplex piston
Single and Duplex Outside Packed Plunger
Single, Duplex and Compound Hydraulic
Steam Heat Vacuum
Automatic Pump and Receiver, etc., etc.

Send your pumping problem to us; our Engineers will recommend the right pump for the job.



Warren Type "L" Single-Stage Single-Suction Liquor Pump

Warren 14-in. Single-Stage Double Suction Pump



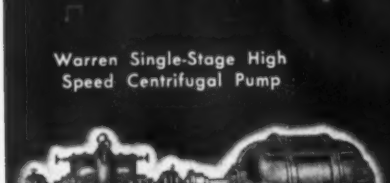
Warren Heavy Liquid Centrifugal Pump

Warren Two-Stage Volute Centrifugal Pump

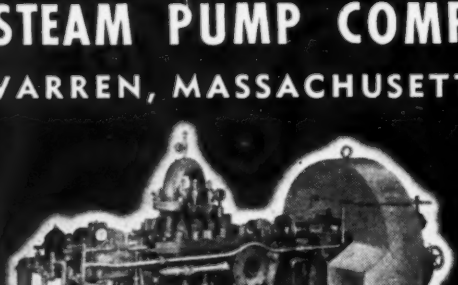
ARMY E NAVY

WARREN STEAM PUMP COMPANY, INC.

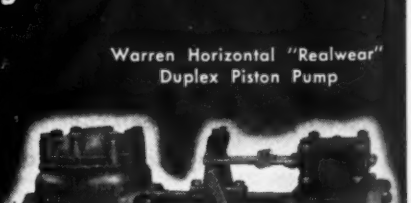
WARREN, MASSACHUSETTS



Warren Single-Stage High Speed Centrifugal Pump



Warren Four-Stage Boiler Feed Pump



Warren Horizontal "Realwear" Duplex Piston Pump

Pardon me for feeling pretty good about COAL

THAT'S a user of Champion Coal talking. We're operating shorter of manpower than we ever thought possible. We're finding maintenance and repair of mechanical equipment more of a problem every day. Yet, in spite of these and other difficulties, we're producing record tonnages, and—except for such recent contingencies as snowbound areas and car embargoes—*our commitments on Champion Coal have been kept.*

There's another and even more basic reason why Champion Coal users "feel pretty good." That's because Champion is always a *quality* product—a fine natural coal, mined by advanced methods and accurately cleaned and sized to suit your needs in huge modern preparation plants. You can depend on Champion in *every* way.

PITTSBURGH COAL COMPANY
Oliver Bldg., Pittsburgh, Pa.

A VITAL SOURCE OF HEAT, STEAM, POWER, AND RAW MATERIALS

Champion Coal

BARTLETT-SNOW
PLUG FEED SKIP HOIST LOADING GATES
OFFER MANY *Outstanding* ADVANTAGES

● Conceived and perfected by Bartlett-Snow engineers, originators of the first fully automatic skip hoist in 1907—and thoroughly proven in service—Bartlett-Snow Plug Feed Type Skip Hoist Loading Gates are of self damming design assuring quiet,— dependable,— non-spilling operation.

Essentially the gate consists of a hopper-like upper section, and a lower pivoting member, hinged to the upper member, and held in closed position with a latch. As the skip bucket descends, arms on the back of the bucket unlatch the pivoting part of the gate without friction or banging, permitting it to swing downward, supported on rollers on the bucket, to bring the spout into position, well inside the skip bucket. The material feeds through until the skip bucket is filled, and the material dammed. After a predetermined pause, controlled electrically, the bucket starts upward, closing and relatching the gate.

These gates are of ingenious design and sturdy, dependable construction. They operate without friction, and consequently encounter little wear. There is no spillage,— no jar,— and no noise, even when the skip bucket is traveling at quite high speeds,— and no counterweights or electrical mechanisms in the pit to require adjustment.

But send for Bulletin No. 92. It gives complete details,— dimensions of the 11 standard sizes,— and contains much information of interest to engineers and operating men.

THE C. O. BARTLETT & SNOW CO.

6205 HARVARD AVENUE • CLEVELAND 5, OHIO

Engineering and Sales Representatives in Principal Cities

COAL HANDLING FOR CENTRAL STATIONS AND INDUSTRIAL BOILER PLANTS

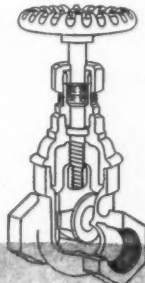
TRACK HOPPERS • SKIP HOISTS • BUCKET ELEVATORS • BELT CONVEYORS
BINS AND BUNKERS • WEIGH LARRIES • FIELD STORAGE • ASH HANDLING

American industry flows through fairbanks valves

STEEL... strength of a nation

Supplier of sinew for mighty war machines, steel means business from the first flares of its fiery birth. To the clang of giant hammers shaping it to man's use, steel as a metal and as an industry is piling up a year-after-year performance record that staggers imagination.

Steel is vital to our economy in a way no other material can parallel. And in no other field is the service of valves by the thousands more important to steadily-maintained high levels of essential production.



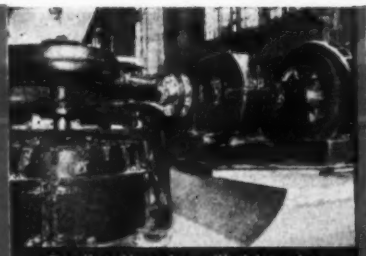
The large quantities of Fairbanks Valves used in the steel industry afford a striking example of what we mean when we say "American Industry flows through Fairbanks Valves." This wide line of bronze and iron valves is backed by more than fifty years of frequent advances in manufacturing . . . consistent improvements in materials.

Fairbanks Catalog Number 42 gives specifications, prices. If it's not in your files now, we suggest you write today. When we send it, we'll advise you of nearest distributor.

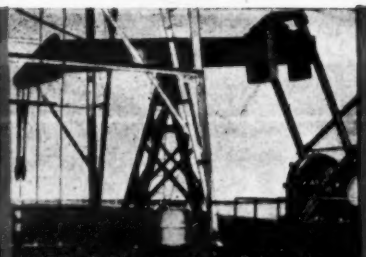
THE fairbanks COMPANY

393 LAFAYETTE STREET, NEW YORK 3, N. Y.

520 Atlantic Avenue, Boston 10, Mass. • 15 Ferry Street, Pittsburgh 22, Pa.



Bradley Hercules mill driven by Jones herringbone speed increaser from synchronous motor.



Oil field pumping unit using single type herringbone reducer driven by belt from gas engine.

JONES Drives that are helping speed up wartime production

• Today every phase of war work calls for drives that will stay on the job. Jones Speed Reducers have been built for long, trouble-free service. And the records established by these speed reducers in 24 hour a day service show that they have the ruggedness and stamina for which all Jones Transmission Products are known.

The accompanying illustrations are presented to give a general idea of the services the Jones organization is prepared to render on drive problems where speed reducers are required.

If you would like to have a condensed picture of the Jones products and engineering services, that are being widely used by industry, just ask for Bulletin No. 80, "Jones Drives for Industry".

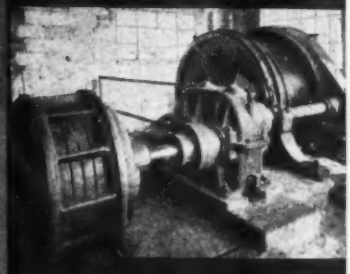
W. A. JONES FOUNDRY & MACHINE CO.
4423 Roosevelt Road, Chicago 24, Illinois

Jones

HERRINGBONE — WORM — SPUR — GEAR SPEED REDUCERS • PULLEYS • GEARS • V-BELT SHEAVES • ANTI-FRICTION PILLOW BLOCKS • FRICTION CLUTCHES • FLEXIBLE COUPLINGS

Hydraulic dredge which was equipped with Jones reducers as shown in view below.

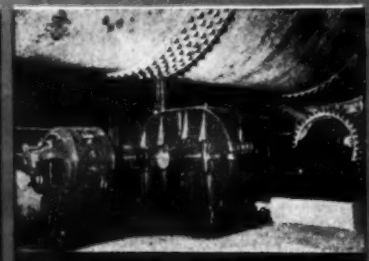
Drums and control mechanism of hydraulic dredge driven through Jones reducers.



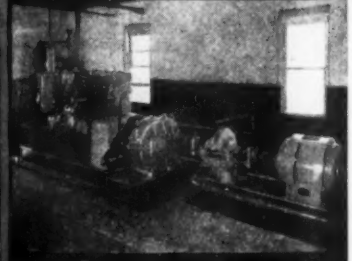
A hoist for a coal mine driven by a Jones herringbone speed reducer.

Jones worm-helical speed reducer driving an agitator in a paper mill.

Centrifugal pump driven by a Jones speed increaser from belt drive to single cylinder gas engine.



A rotary kiln in a cement plant driven by Jones herringbone speed reducer.

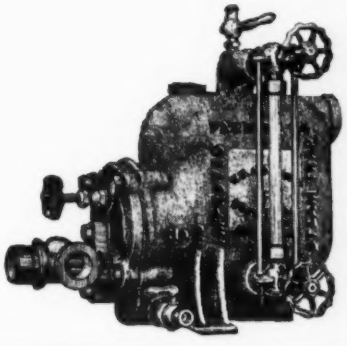


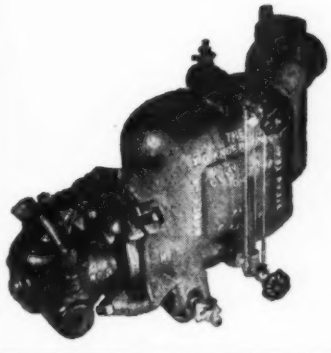
Jones speed increaser driving a centrifugal pump from a Diesel engine.

Through 3 WARS *with*
ANDERSON STEAM TRAPS

1898-1902

Back in 1898, when the Spanish-American War and the Philippine Insurrection were taking place, The V. D. Anderson Company was manufacturing and selling the Model "N" Steam Trap, shown at the right, as the most dependable means of draining condensate from steam lines.





1917-1918

When the boys sailed for Europe in 1917, to fight in World War I, an improved Float Trap, Model "D," was serving steam trap users. This trap is still giving dependable service on many steam lines.

1941-194X

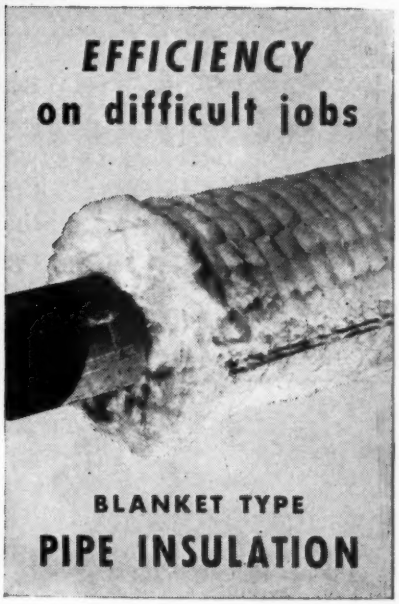
As we enter the fourth year of this war, the popular Anderson Super-Silvertop Inverted Bucket Steam Traps are draining condensate in thousands of industrial concerns making war supplies.

Today's Super-Silvertop Steam Traps lead in efficiency and economy, but even today's Super-Silvertop may be superceded by a better trap in years to come. One thing you can depend upon—Anderson Engineers, with over a half century of steam trap experience, will continue to provide steam trap users with the most efficient and economical means of draining condensate.

THE V. D. ANDERSON COMPANY
1934 WEST 96th STREET • CLEVELAND 2, OHIO

Super-Silvertop
—STEAM TRAPS—

★pipes "tough" to insulate



..another job for

FIBERGLAS*

BLANKET TYPE
PIPE INSULATION

In co-operation with the Government program to save critical fuel.

Many conditions which present difficulties for other types of insulation are efficiently overcome when Fiberglas Blanket Type Pipe Insulation is used.

It is particularly well adapted for application on riveted or welded pipes and on pipes that do not conform to standard dimensions. It assures a perfect fit over protruding rivets and can be used on any size pipe from 3" to 42" in diameter. This type of Fiberglas insulation is designed for insulating pipes at temperatures up to 1000° F.

Light in weight, Fiberglas Blanket Type Pipe Insulation is easy to handle and apply.

It is made of Fiberglas Insulating Wool, type TW-F, an exceptionally efficient blanket of fine, long, strong, interlaced fibers *requiring facing on one side only!* The wire mesh used to face the outer surface is secured to the Fiberglas by asbestos yarn ties. Available in standard 2 ft. sections. An extra inch of insulating wool at each end assures an intermeshed, heat-tight joint.

A sheet metal selvage is provided at the ends of the blanket. In application the selvages are simply laced together with galvanized wire. On bends the insulation is cut to shape and the selvages are laced together on the outside radius, permitting the mesh on the inside to conform to the contour of the pipe. When properly applied, uniform thickness and density of insulation are assured.

There is a form of Fiberglas insulation to meet every need. Write for your copy of "Fiberglas Insulations for Industry". *Owens-Corning Fiberglas Corp., 2000 Nicholas Building, Toledo 1, Ohio. In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.*

FIBERGLAS INDUSTRIAL INSULATIONS

1. PF Pipe Insulation—A lightweight, preformed pipe covering with high insulating efficiency for temperatures up to 600° F. Made in 3-ft. sections or segments for all standard pipe sizes. Fibrous ends of sections intermesh to form tight joints.

2. Metal Mesh Blankets—With mesh wire or expanded metal on one or both sides. Lightweight and easily applied. 2 ft. x 4 ft. and 2 ft. x 8 ft. In standard thicknesses. Two types: For temperatures up to 600° F. and 1000° F.

3. No. 600 PF Block—Same materials as in PF Pipe Covering — in blocks 6" x 36" and 12" x 36", standard thicknesses.

4. OC-1800 High Temperature Block—A highly efficient molded block in sizes 3" x 18" and 6" x 36" and 12" x 36"—in standard thicknesses. Will withstand surface temperatures up to 1800° F.

5. Insulating Cement—For insulating fittings, valves and all irregular surfaces. Highly efficient . . . withstands temperatures up to 1200° Fahrenheit.

6. OC Mastic Finish—An asphalt emulsion cement for insulated pipe and equipment exposed to outdoor or high moisture conditions.

7. Insulating Wool, Type TW-F—Available in bats, rolls and bulk. Used for drying-ovens, heaters, etc., for filling irregular spaces.

8. PF Insulation—Manufactured in 5 densities from 2½ to 9 lbs. per cu. ft.—standard sizes 24" x 48", 1" to 4" in thickness, according to density. For insulated panels, sound absorption and various semi-structural applications.

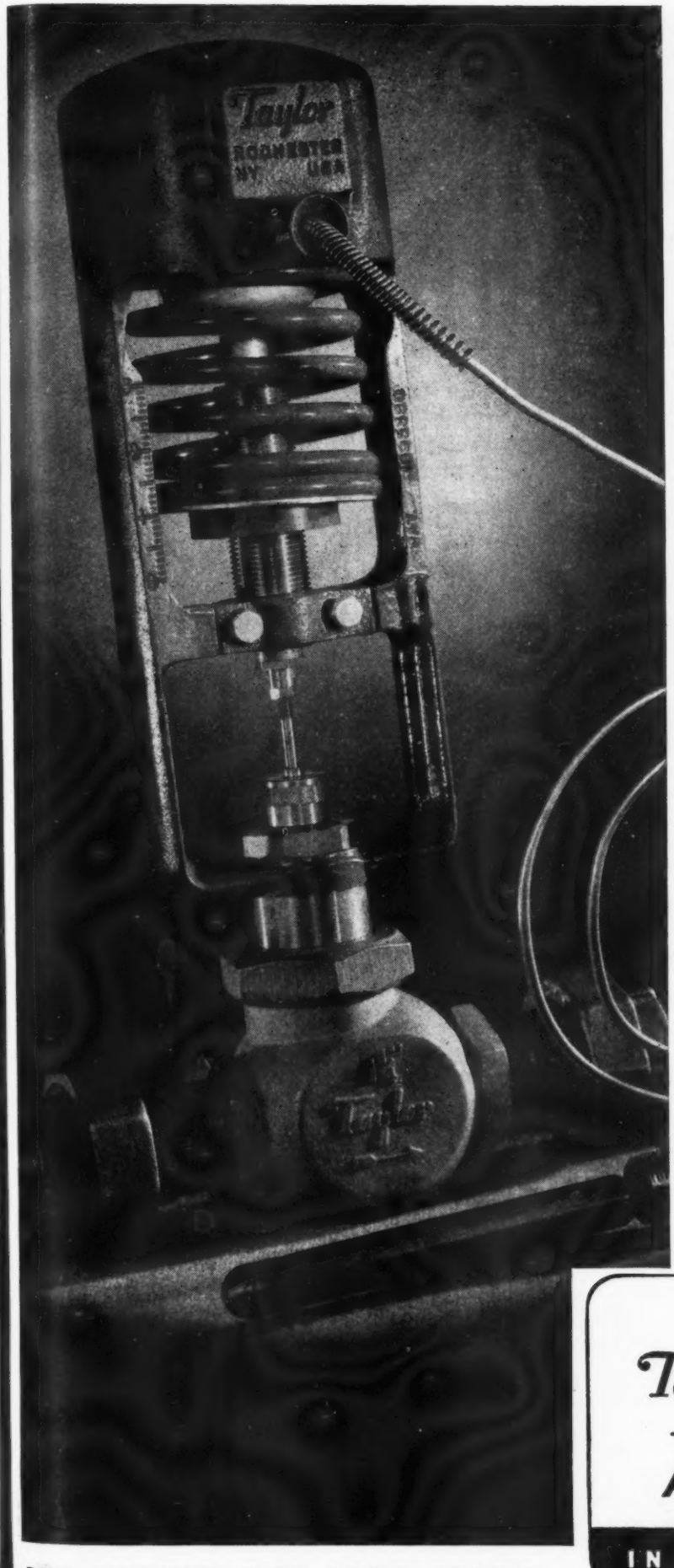
9. PF Roof Deck Insulation—9 lbs. density with facing to facilitate mopping. Highly efficient, with incombustible, rotproof and moisture-resistant core, for application under industrial built-up roofings. Sizes 24" x 48". Thicknesses from 1½" to 2".

ARMY E NAVY

FIBERGLAS

*Trade Mark Reg. U. S. Pat. Off.

INDUSTRIAL INSULATIONS



DON'T SEND A MAN ON A BOY'S ERRAND!

MAYBE our ads are too good, we don't know. But sometimes our customers get *too* enthusiastic about our temperature controllers. They ask for a Taylor Fulscope Air-operated Controller when (it hurts to say this) a simple Taylor Self-Acting Controller would be entirely adequate for many jobs.

It's true that on continuous process control systems, or wherever else you may run into variations of flow or pressure, you need the adjustable sensitivity of a Fulscope. But on hot water service tanks, Diesel engine water jackets, compressor water jackets, water heaters, glue kettles—places where there are no big changes in load conditions—a Taylor Self-Acting Controller with its fixed sensitivity is just what you need. It requires no auxiliary air supply. You'll find it inexpensive and easy to use, with practically no maintenance cost. See your jobber or write Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada. *Instruments for indicating, recording, and controlling temperature, pressure, humidity, flow and liquid level.*

ARMY E NAVY

Taylor Instruments

MEAN

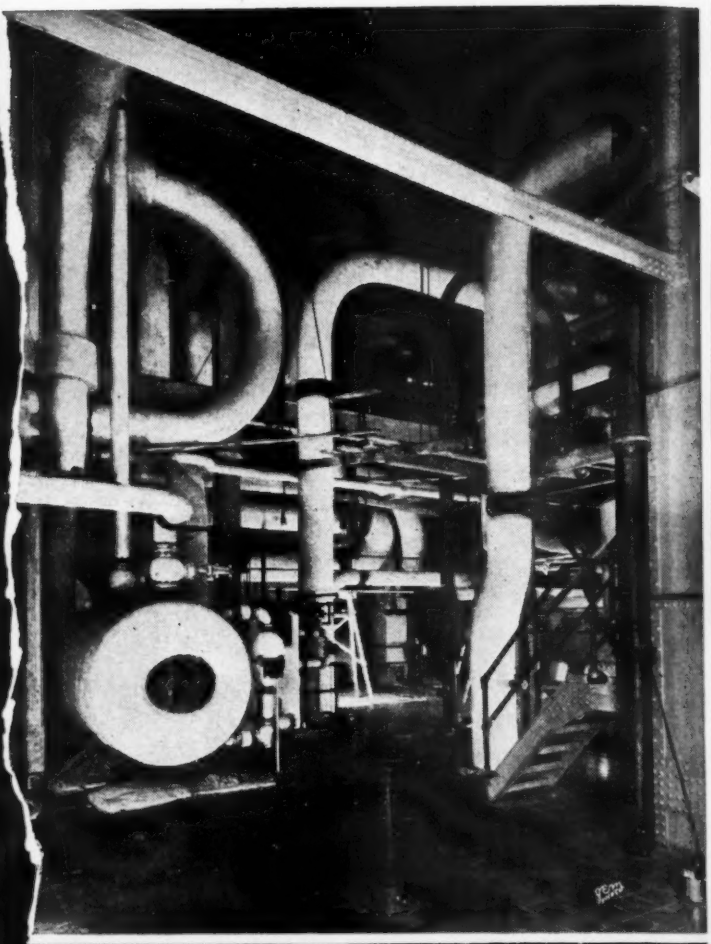
ACCURACY FIRST

IN HOME AND INDUSTRY

BUY ANOTHER WAR BOND TODAY!

What NAVCO means to Piping

SKILLED ENGINEERING
CORRECT DESIGN
MODERN FABRICATION
ACCURATE WORKMANSHIP



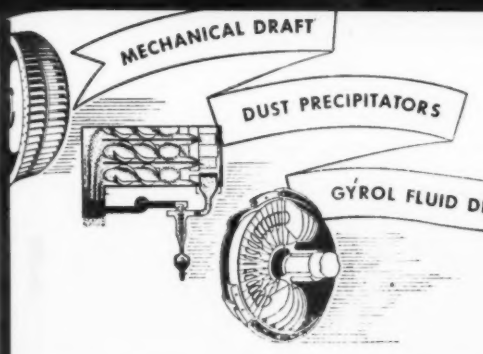
A background of 36 years experience in engineering and designing, in addition to employing the most modern methods available, are your assurance of obtaining highest quality materials and workmanship.

For your piping problems,
consult Navco

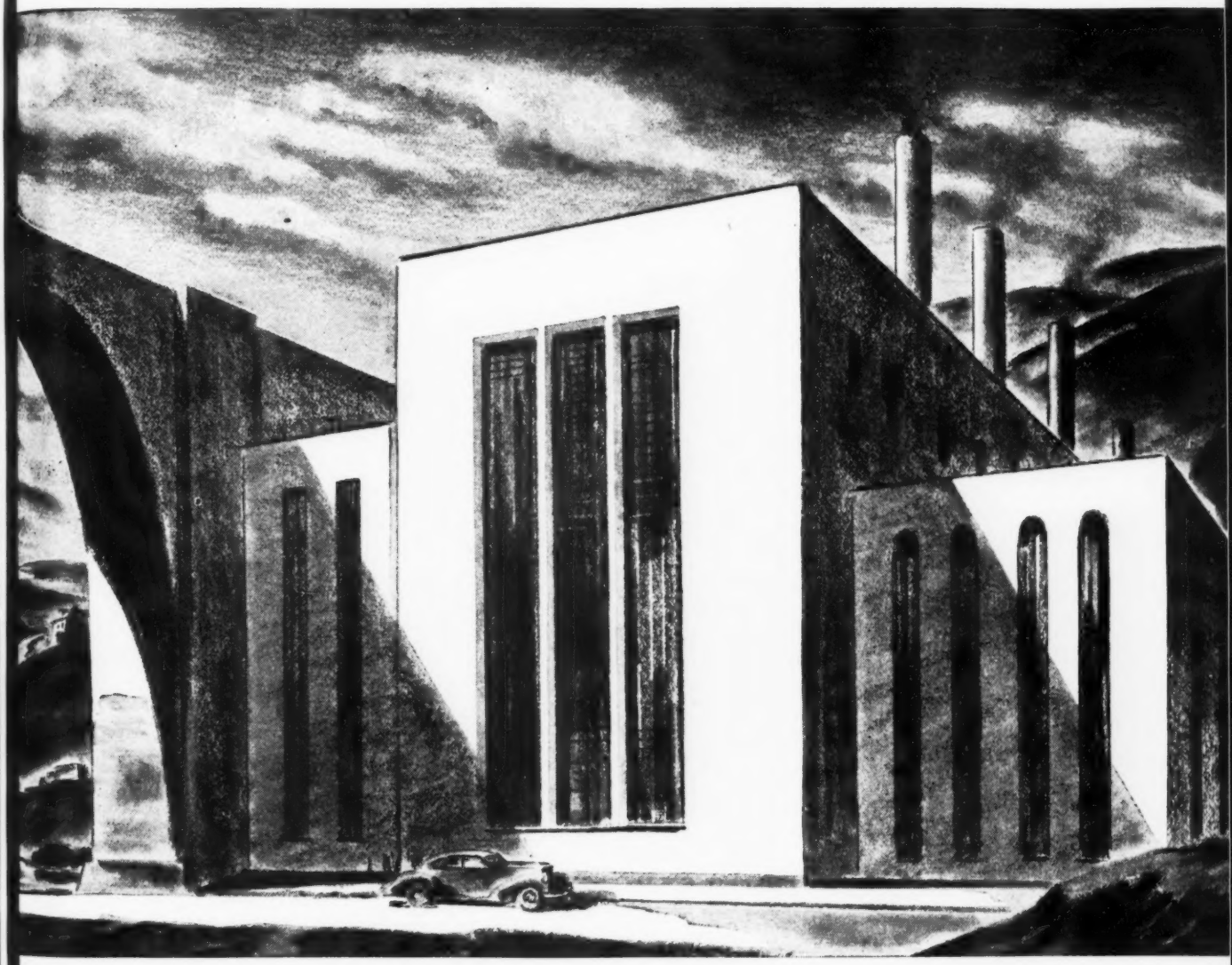
NATIONAL VALVE & MFG. CO.
PITTSBURGH, PA.

NAVCO

NAVCO PIPING



You can buy all 3 from me



Call in an American Blower representative. Let him show you why it is to your advantage to buy American Blower Mechanical Draft Fans, Gyrol Fluid Drives and ST Dust Precipitators as a group from *one* source of supply . . . One purchase order, one source of technical information, less red tape, better service and greater all-around satisfaction, are a few of the many benefits to you of buying all 3 from A.B.C.

W TO SOLVE YOUR FLY ASH PROBLEMS. 1) Carefully select a sample of the terial you wish collected (our engineers will send you complete instruc- s for gathering and packing sample or they will gather a sample for). 2) Ship your sample to the American Blower Dust Testing Labora- y (shown on right). We'll run tests, determine the equipment best suited do your individual job, and give you complete data on installing erican Blower time-proved Dust Precipitators. In the last 20 years, we e run tests on more than 4100 distinctly different materials. Our experi- ed engineering staff and the finest facilities in the industry for test- designing and building Dust Precipitators assure your satisfaction.

AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation

TROY-ENGBERG

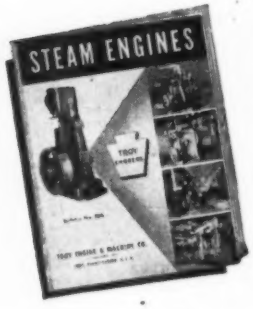
★ ★ ★

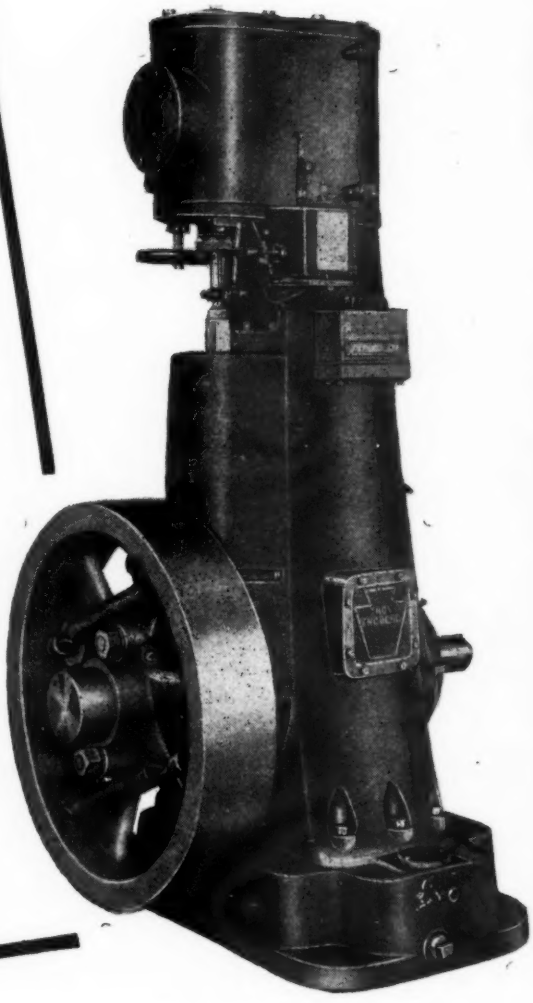
POWER That Soon Becomes Almost "Free" POWER

By "free" power, we mean that in a relatively short time the Troy-Engberg Steam Engine has completely paid for itself and from then on delivers power at so little cost as to be almost negligible. It can do this because it operates on steam intended primarily for processing or heating. It extracts the power and exhausts most of the heat units. It is what we call By-Product Power.

Low Cost By-Product Power has been responsible for placing the Troy-Engberg Steam Engine in thousands of plants driving stokers, pumps, compressors, fans, generators and other equipment. Why not investigate its possibilities for your plant?

Send for our New Bulletin No. 306





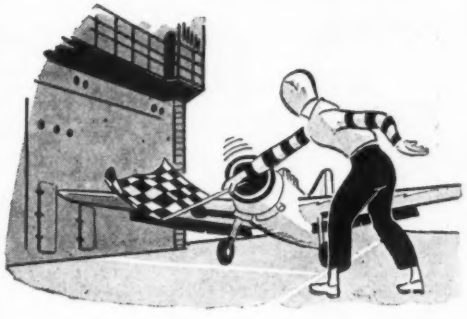
TROY ENGINE & MACHINE CO.

ESTABLISHED 1870

2500 RAILROAD AVENUE, TROY, PENNSYLVANIA

3-TEM-3

THE WAR...
YOUR ELEVATORS...
AND YOUR EYES



1. On flat-tops, battleships, and cruisers, Otis precision-built elevators have been and are today serving the United States Navy on the seven seas. From our experience in providing this equipment have come marked improvements in design, new manufacturing techniques, and a store of knowledge destined to provide still further improvements in Otis Elevators after the war.

2. Today, therefore, when planning the modernization of your present equipment, give particular consideration to Otis Elevators. This company, with 244 offices throughout the United States, is in a position now to cooperate with you in the preparation of plans and surveys.

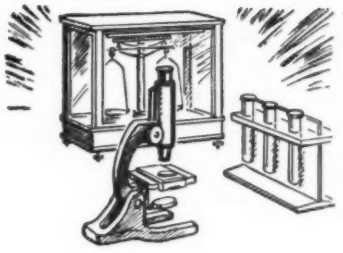
3. *So, keep your eyes on Otis.* In the days ahead, this company, through the continued use of advanced methods and new skills, will, as in the past, be ready to assure you of the last word in efficient and economical vertical transportation.

Remember, there is an Otis representative as near as your telephone. He will be glad to discuss future plans for new elevator or escalator installations or the modernization or maintenance of existing equipment. Call him today.

Otis ELEVATOR COMPANY

OFFICES IN ALL PRINCIPAL CITIES

CARE*



. . . . the watchword in qualifying material for Marsh Gauges . . . .

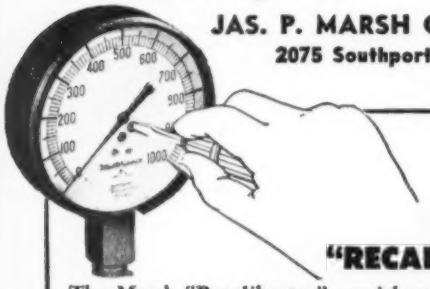
THERE is a too prevalent theory that good design and careful workmanship can make up for the faults of poor material. We don't accept that idea here at the Marsh plant. We believe that to come out right, we must start right. So the lasting accuracy you have come to associate with Marsh Pressure Gauges begins with meticulous selection of the materials that go into them.

One of the best examples of this is the verifying of the tubing used for bourdon tubes. This tubing is the heart of the instrument. If it lacked the required resiliency it would take a "permanent set"—fail to return to its original arc when pressure ceased. That's why we micrometer every length of it as illustrated here . . . test its hardness on the device shown . . . bend and form it by exclusive Marsh methods.

You will find similar examples of carefully selected material in every detail of Marsh Gauges. And while it is true that Marsh design and precision workmanship are the final factors in making Marsh Gauges "The Standard of Accuracy", the story of making a superlative gauge would not be complete without this painstaking verification of materials.

Naturally material that will pass such rigid inspection costs more. But its cost is well justified in the finer pressure gauges, and dial thermometers that we are enabled to produce.

JAS. P. MARSH CORPORATION
2075 Southport Ave., Chicago, Ill.



THE GAUGE WITH THE "RECALIBRATOR"

The Marsh "Recalibrator"—quickest and best way to correct a gauge that has been knocked out of adjustment—the finishing touch to a superlative gauge.

Ask Mike if it's right . . . Every length of tubing is gauged with a micrometer; then tagged and classified here for use in bourdon tubes.

No permanent waves wanted . . . A "permament set" is n. g. in a bourdon tube. Here each lot of tubing is tested for hardness to make sure it doesn't have this fault.

Form counts . . . Tubes for heavier gauges are heat treated and formed here.

MARSH HEATING SPECIALTIES
DIAL THERMOMETERS **GAUGES**

** One of a series of advertisements covering the factors that make Marsh instruments "THE STANDARD OF ACCURACY"*

Antimony added to *Admiralty* in CHASE

ANTIMONIAL ADMIRALTY*

increases resistance to dezincification without increasing the initial cost of the tubes

To produce a thoroughly reliable, and economical, condenser tube alloy for salt or brackish cooling water conditions, Chase added antimony to Admiralty. Result? During the past nine years, *millions* of pounds of Chase Antimonial Admiralty have been installed... and not a single service failure from dezincification has been reported.

Yet while the presence of antimony in this alloy reduces considerably the annual costs of condenser tubes (by increasing resistance to dezincification), there is no increase in the *initial* cost of the tubes. Longer service life... important savings in tube replacements — you enjoy *both* with Chase Antimonial Admiralty.

THINGS TO REMEMBER about Chase Antimonial Admiralty. It is (1) highly resistant to dezincification; (2) virtually immune to intercrystalline corrosion; and (3) costs no more than plain Admiralty.

For details phone your nearest Chase Warehouse or Service Office.

* U. S. Pat. No. 2,061,981

CHASE

SPECIAL STOCKS OF ANTIMONIAL ADMIRALTY at HOUSTON LOS ANGELES NEW ORLEANS SAN FRANCISCO TULSA

CHASE BRASS & COPPER CO.

— Incorporated —

Waterbury 91, Connecticut

SUBSIDIARY OF KENNECOTT COPPER CORPORATION

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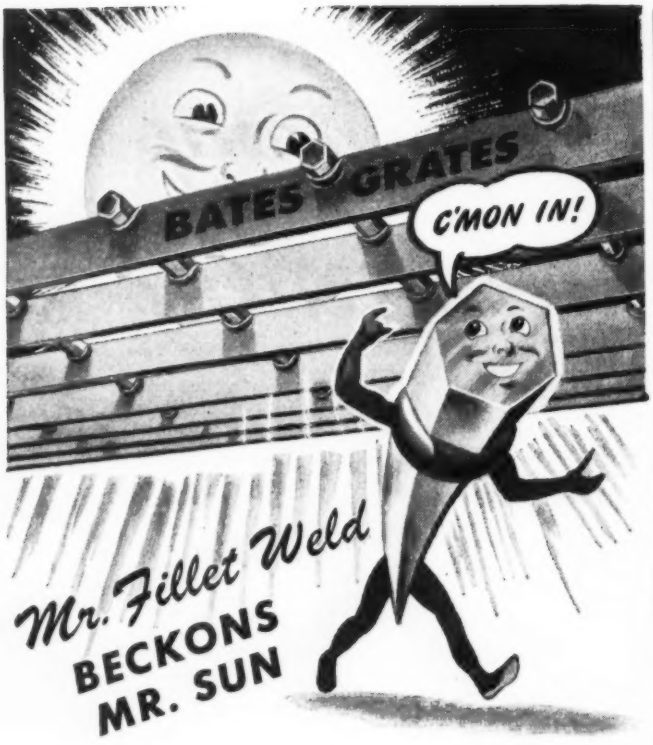
MINNEAPOLIS NEWARK NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH PROVIDENCE ROCHESTER † SAN FRANCISCO SEATTLE ST. LOUIS WASHINGTON †

† *Indicates Sales Office Only*

This is the Chase Network — handiest way to buy brass



• *Mr. Fillet Weld* sees a lot of Mr. Sun. You see, *Mr. Fillet Weld* holds the Hex Cross Bars of BATES•GRATES to the main bars. In doing so, he allows maximum transmission of light and ventilation through the grating. The reflecting bevels of the Hex bars and 90° corners make this possible.

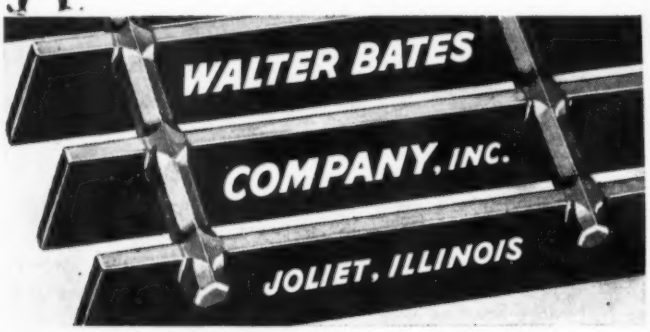
Good light and ventilation are important in every plant, as you well know.

that's only one reason why

BATES•GRATES are better

• The fact that BATES•GRATES allow more light and better air circulation is only one of the distinctive advantages of BATES. The Fillet Welded Hex Cross Bars make BATES stronger. The crisp, clean edges of Hex and main bars also give you sure-footed safety. They are easier to clean and maintain. All this adds up to:

Get a bid from BATES on every job where you need GRATES



NOW

How to get the most out of AIR COMPRESSORS

shown in the complete practical guide to efficient and economical

Selection
Installation
Operation
Maintenance

Here is a priceless new manual for every design, plant, or operating engineer concerned with machines and processes involving air compressors. In great detail and the clearest kind of language, and with over 400 explanatory illustrations, it tells everything you need to know about all types of compressors, in order to choose the right kind for a specific installation and to put it in service, keep it in service, and get the most out of it.

Just Out

AIR COMPRESSORS

By EUGENE W. F. FELLER

Operating Engineer, formerly Assistant Chief Operator, Safe Harbor Water Power Corp.; Associate Editor, *Power*

460 pages, 5⅛ x 8¼, 414 illustrations, $4.50

Here's a brief idea of what this helpful book gives you:

—information on the kinds of compressors available, with the pointers on performance, service limitations, etc., needed in selection

—complete mechanical description of every part of reciprocating, two impeller, sliding vane, liquid piston, centrifugal, and axial compressors

—full explanation of load-control devices, compressor lubrication requirements, and other special topics

—instructions and diagrams on location, foundation, erection, alignment, adjustment, and other details of compressor installation

—directions for operating all types of compressors, with special attention on trouble points to watch

—maintenance helps, covering everything from minor adjustments to the making and fitting of piston rings

Procedure for lining up rotating shafts—convenient separate chapter of air compressing theory—material on hydraulic air compressing—comparative costs and pointers on compressor selection—these are other helpful features of this exceptionally thorough and practical manual.

Includes a complete description of the **GAS TURBINE** of which the axial compressor is a necessary accessory, giving you an up-to-the-minute view of the features of this formidable newcomer in the field of power generation.

See it 10 days FREE—Send this coupon

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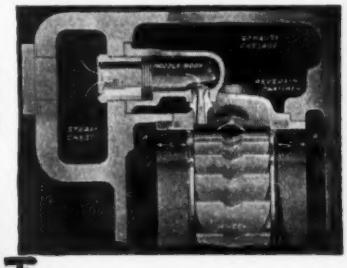
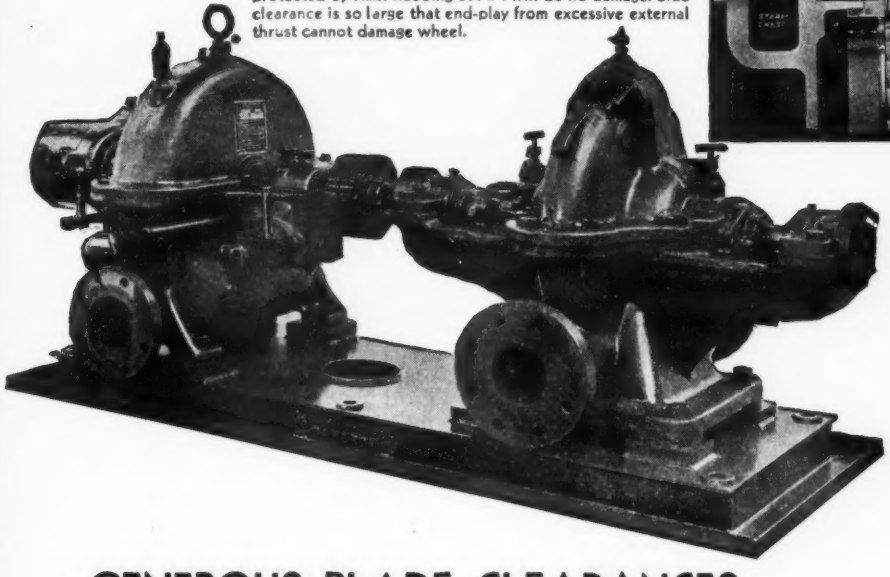
TERRY

DIAGRAM SHOWING WHEEL CLEARANCES

AA—Rim clearance, B—Large blade clearance, CC—Side clearance, (about one inch). Blades cannot foul, as they are protected by rims. Rubbing at AA will do no damage. Side clearance is so large that end-play from excessive external thrust cannot damage wheel.





GENEROUS BLADE CLEARANCES INCREASE TERRY TURBINE DEPENDABILITY

In the Terry Wheel Turbine fine blade clearance is not essential to high operating efficiency. The actual clearance between the moving and stationary blades is greater than ⅛ inch. End play cannot affect this clearance and the side clearance is one inch or more. It is therefore not essential to make frequent adjustments of the thrust to maintain efficient and safe operation.

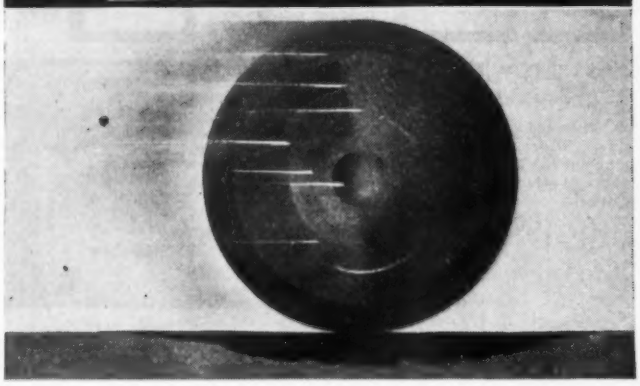
Clearance in the Terry blading may be reduced only by excessive wear of the main bearings, but even if this should occur, the projecting rims on the side of the wheel would rub on the smooth protecting surfaces of the reversing chamber, thereby automatically stopping the turbine before damage could result. Replacement of the interchangeable bearings immediately restores the original clearance.

Details of this durable turbine are discussed in Bulletin S-116.
A request on your business letterhead will bring a copy.

T-1155

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

NO DRYING TIME REQUIRED in Repairing Concrete Floors



Keep your concrete floors • aisles • driveways • platforms • in shape with QUICK-FLOOR . . . a plastic which sets by pressure • quickly and easily applied without interrupting traffic • takes no drying time. Traffic helps it set, establishes the true traffic plane, feathers the edges. QUICK-FLOOR gets harder with use • the repair job will outwear the original concrete.

Repair and resurface your worn wood floors too, if the foundation is rigid.

★ QUICK-FLOOR is unconditionally guaranteed. Write today for full information on your specific floor problems.

DURA-TRED COMPANY

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EVERY BOILER SHOULD HAVE ITS OWN . . . . CAT'S-EYES

FOR BETTER COMBUSTION

THE BEST BOILERS ALSO USE

ESS HAZEGAGES or WYD-ANGLE PERISCOPES

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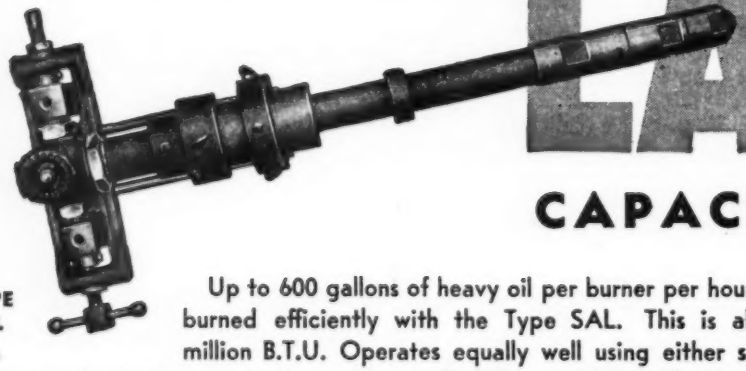
Indicators, Controllers, and Recorders for Smoke Haze and Combustion . . . Specific Gravity . . . Turbidity . . . Flame Failure . . . Industrial and Safety Applications

A NATIONAL AIROIL LARGE CAPACITY OIL BURNER



TYPE SAL

Up to 600 gallons of heavy oil per burner per hour can be burned efficiently with the Type SAL. This is about 90 million B.T.U. Operates equally well using either steam or compressed air for atomization . . . needs only occasional cleaning and a minimum of maintenance.

The SAL is installed frequently as an alternate to pulverized coal, coke or natural gas in boilers up to one million pounds per hour steam capacity.

Our 33 years experience in the manufacture and application of fuel oil and gas burners can help you meet your combustion problems. Call on us.

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ACCESS DOORS • AIR DOORS • BURNER BLOCKS • FURNACE OBSERVATION WINDOWS

NATIONAL AIROIL FUEL OIL - GAS BURNERS

Designed TO WORK MORE EASILY— *Built* TO LAST LONGER—

ASBESTOS-PACKED COCKS

READING-PRATT & CADY

That, in brief, is the story of this double gland Asbestos-Packed Cock—a **READING-PRATT & CADY** "original."

This cock serves best as a shut-off on lines that carry solids in suspension—viscous fluids—oils—acids and alkalis—steam (for boiler blow-off)—in short, wherever Globe, Angle or Gate valves fail or where conventional ground plug cocks prove unsatisfactory. It is made in cast iron, bronze and cast steel.

U-shaped grooves in the body of this cock are packed solidly with asbestos, which is then vulcanized. This provides a bearing which absorbs expansion and eases operation. The double gland feature—independently controlled pressure on plug and top packing—still further eases operation and prolongs life.

R-P & C offers you a single responsible source for bronze, iron and steel gate, globe, angle and check valves—cocks and lubrotite gate valves—bar stock valves—cast steel fittings—D'Este Automatic Valves and Engineering Specialties.

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MULTIPLE SPREADER **STOKERS**

BURN COAL LIKE OIL!

Save with Fyr-Feeder—Burn less coal—Cheaper coal—Local coals—Screenings—Coal yard sweepings, wet or dry—Wet coal is no handicap.

FYR-FEEDER

exclusively employs

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Fines burn in suspension, larger pieces are spread evenly over grates.

Fyr-Feeder increases boiler capacity—responds instantly to sudden load variations—requires no special skill or experience to operate—thin fuel bed eliminates clinkers—makes firemen's work much easier—no banking losses.

CHANGE OVER TO FYR-FEEDER NOW

Easily installed in minimum time

Fyr-Feeders are built in sizes to burn from 300 to 12,000 lbs. of coal per hour. If you are or expect to be in the market for automatic coal burning equipment

Wire or Write

AMERICAN COAL BURNER CO.

Engineers

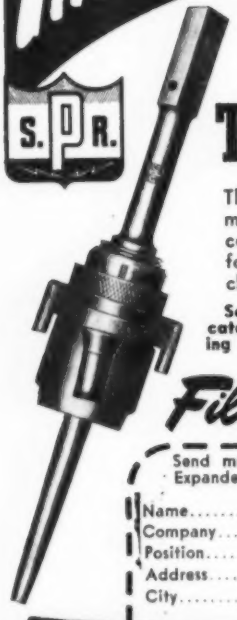
32-18 E. Erie St. Chicago 11, Ill.

Investigate—

POWERS ~~*LIGHTNING*~~

S.P.R.

TUBE EXPANDERS



Thousands of Powers lightning precision-made tube expanders are being used successfully all over the world by our armed forces, boiler manufacturers, heat exchanger manufacturers, refineries, etc.

Send today for our new 1945 complete catalogue covering all tools and engineering data.

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QUAKER PACKINGS...

Wherever there is steam to be kept under control there is a style and type of Quaker Rod and Sheet Packing to suit the particular condition.

Specify QUAKER

Make sure you get the proper packings that will give you the best results—see that your orders specify QUAKER. And remember there is a Quaker Packing to meet any service condition, for it is *the* complete packing line.

For old equipment, for new equipment . . . for all kinds of service conditions . . . low pressures, or high pressures . . . cold water or steam . . . water, oil, acids or any other kind of liquid . . . air, steam, vapor or vacuum. Regardless of the service you may require, there is a Quaker Packing to meet that condition.

Consult Quaker if you have any packing troubles. Our Packing Experts are at your service any time.

If there is a way to get it done **QUAKER** *will do it*

Reg. U. S. Pat. Off.

QUAKER RUBBER CORPORATION

Mfrs. Industrial Rubber Products

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Western Territory

Quaker Pacific Rubber Company

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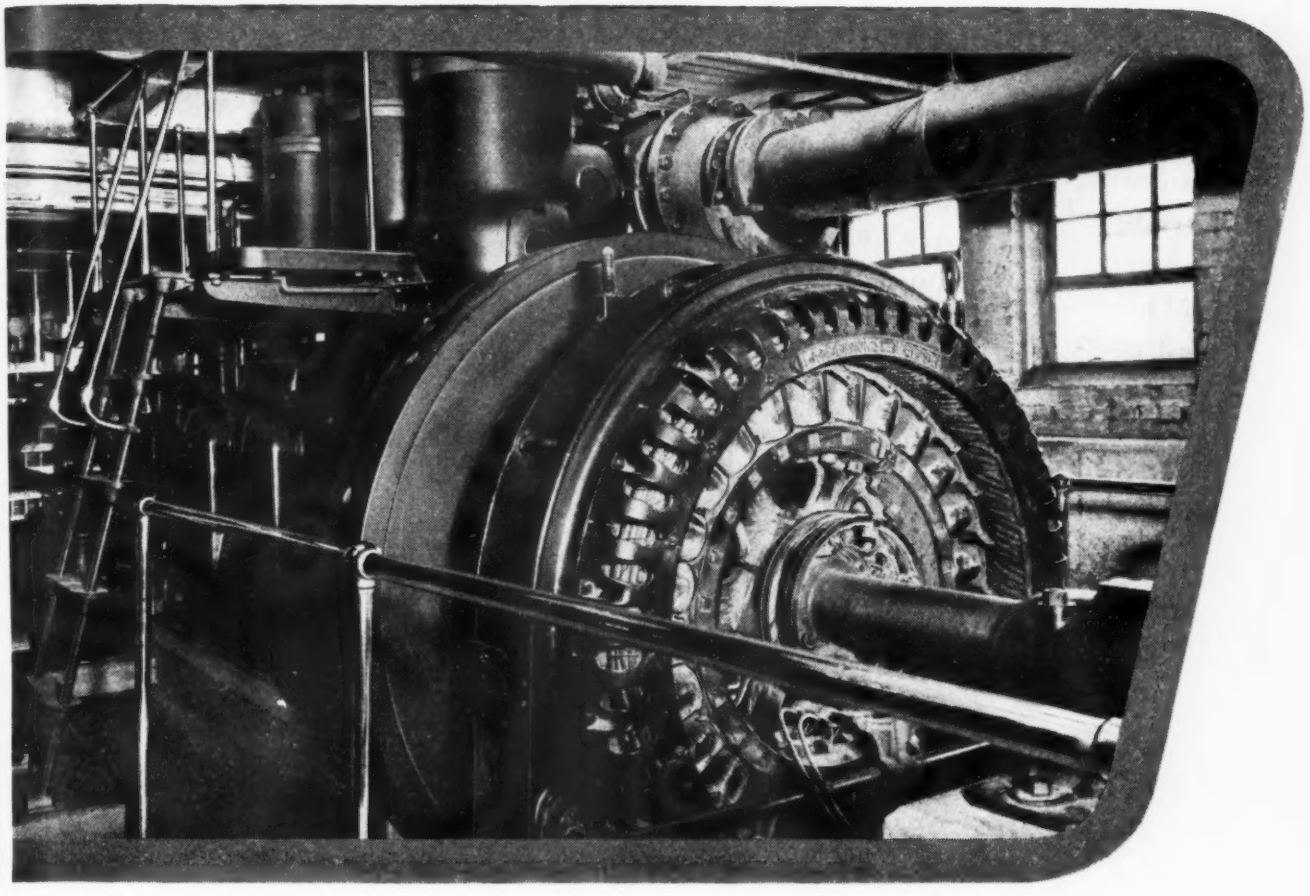
Power Costs Drop *80%* at Plating Plant



One of the two Fairbanks-Morse Diesels in operation at the Grand Rapids Plating Co.

By installing two Fairbanks-Morse Diesels, the Grand Rapids Plating Co. reduced its cost of power from $50 to $10 a day. The $10 includes fuel, lubrication, and operation and maintenance costs. This record was established in 20,000 hours of sustained service.

This means the Fairbanks-Morse Diesels have saved enough to pay for themselves. And, such dependable, low-cost power is available for your needs, too. Write Fairbanks, Morse & Co., Fairbanks-Morse Building, Chicago 5, Illinois.

BUY MORE WAR BONDS

Fairbanks-Morse

A name worth remembering

Diesel Locomotives · Diesel Engines · Generators · Motors · Pumps · Scales
Magnetos · Stokers · Railroad Motor Cars and Standpipes · Farm Equipment

District or Central Heating Faces Bright Future

During the war, hundreds of thousands of people have been introduced to the convenience and comfort of district or central heating in housing projects and army or navy bases from coast to coast. As a result, new district heating projects will find a receptive public.

Obsolescence of existing district or central heating systems created by war has resulted in a big backlog for materials, equipment and service.

ALL THIS WILL RESULT IN A

BIG DEMAND

for

ADSCO-BANNON

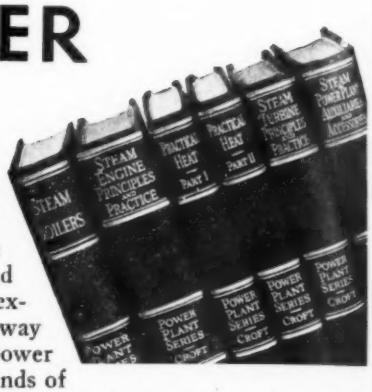
TILE CONDUIT

Made of vitrified clay tile, insulated with "Fiberglas" insulation, it is a combination that can't be topped for permanency or efficiency. Split-tile construction makes it easy to install a group of pipes. Can be furnished for several combinations of pipe in the same conduit thereby reducing cost. Write for Bulletin Number 35-67 PR.

AMERICAN DISTRICT STEAM COMPANY NORTH TONAWANDA, N. Y.

Makers of "UP-TO-DATE" Steam Line Equipment For Over 65 Years

There's always room and BIG PAY *in* POWER


STEAM BOILERS
STEAM ENGINE PRINCIPLES AND PRACTICE
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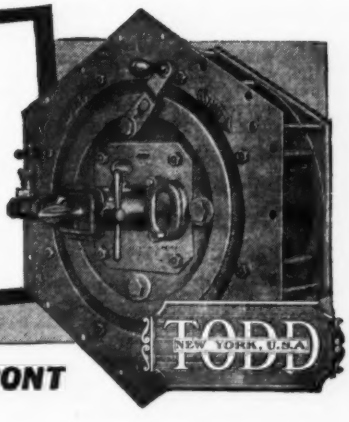

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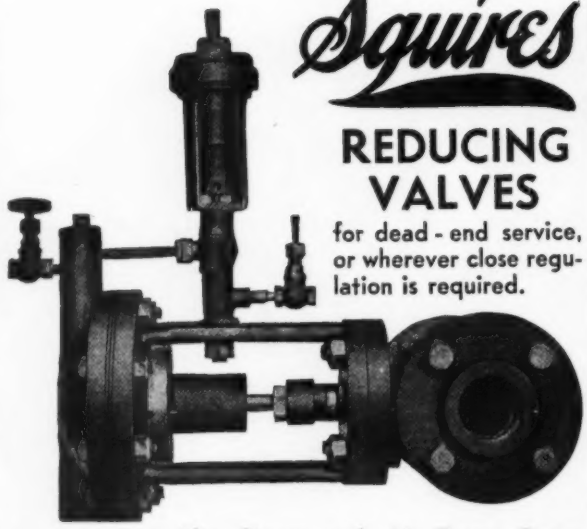

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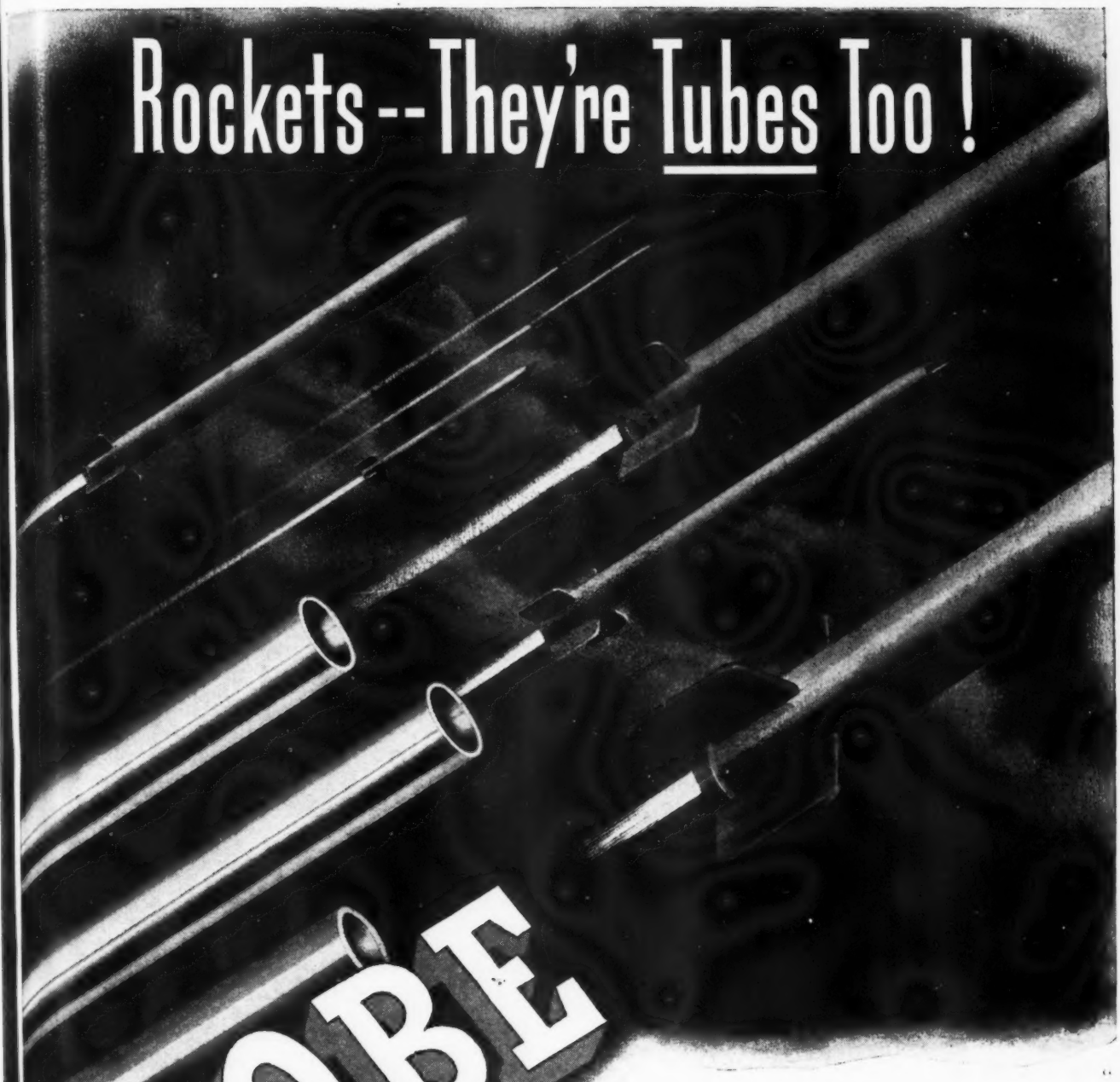

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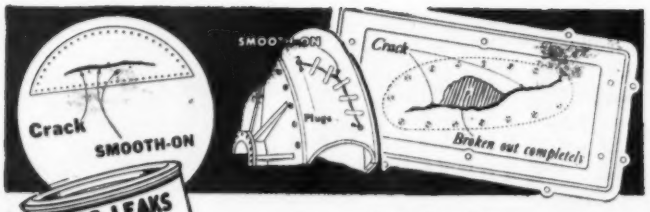

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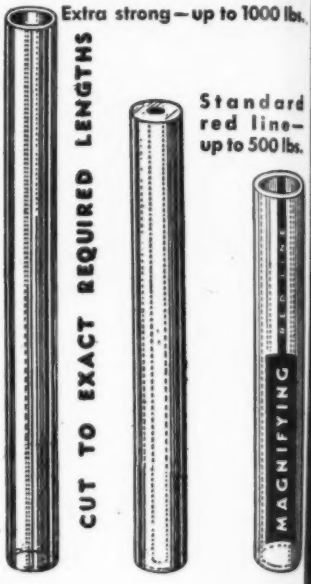

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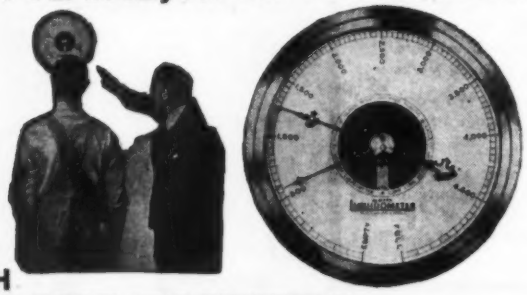

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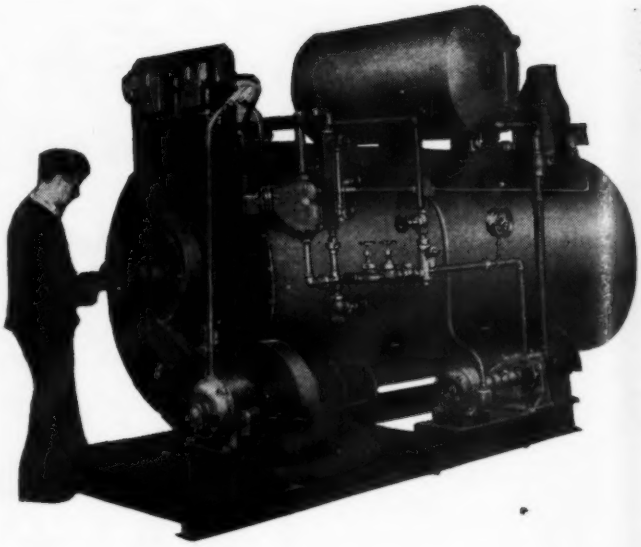

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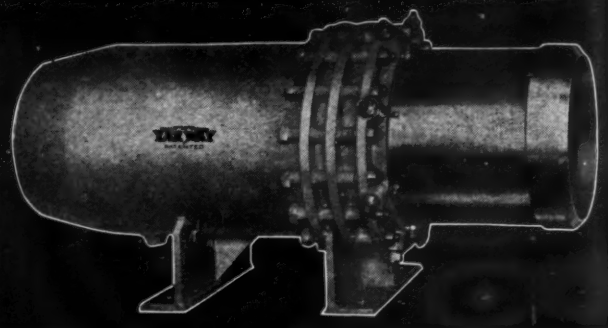

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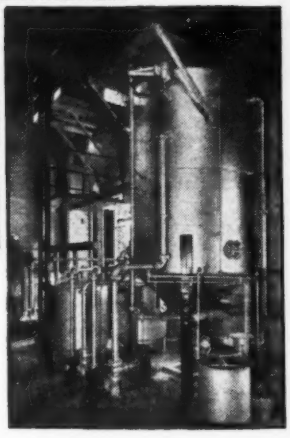

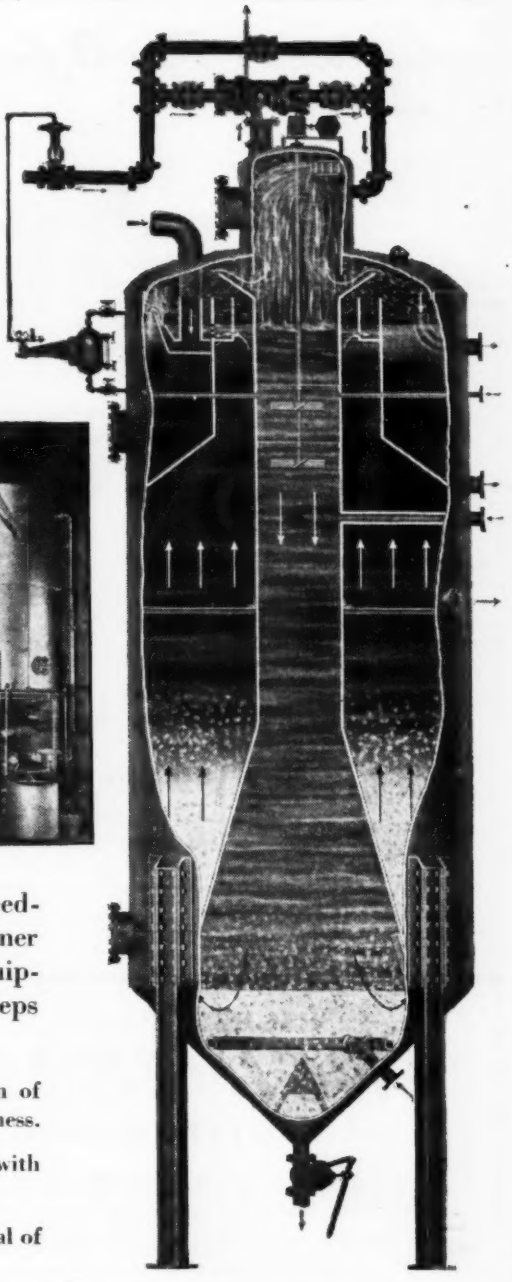

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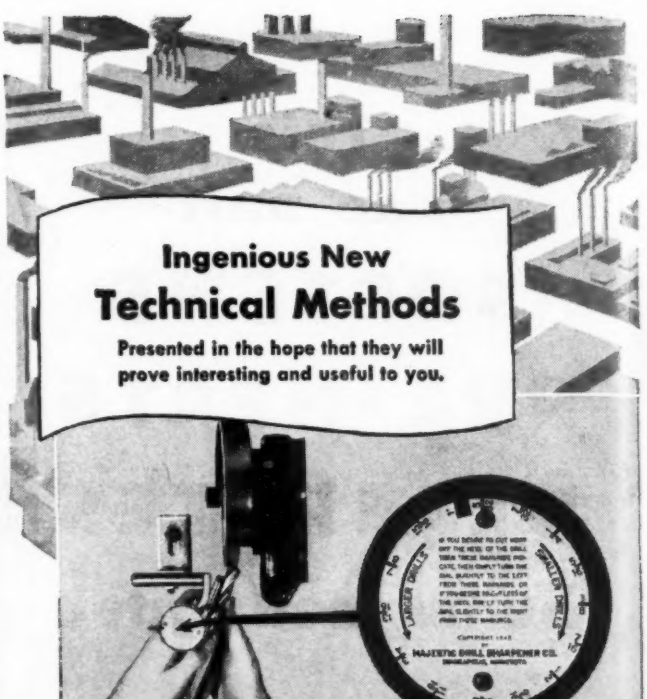
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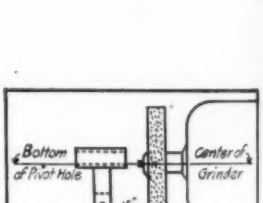
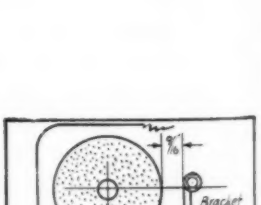


Front view of grinder



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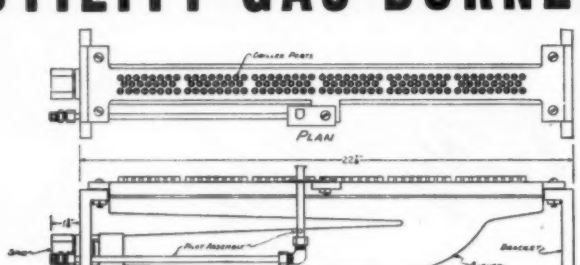

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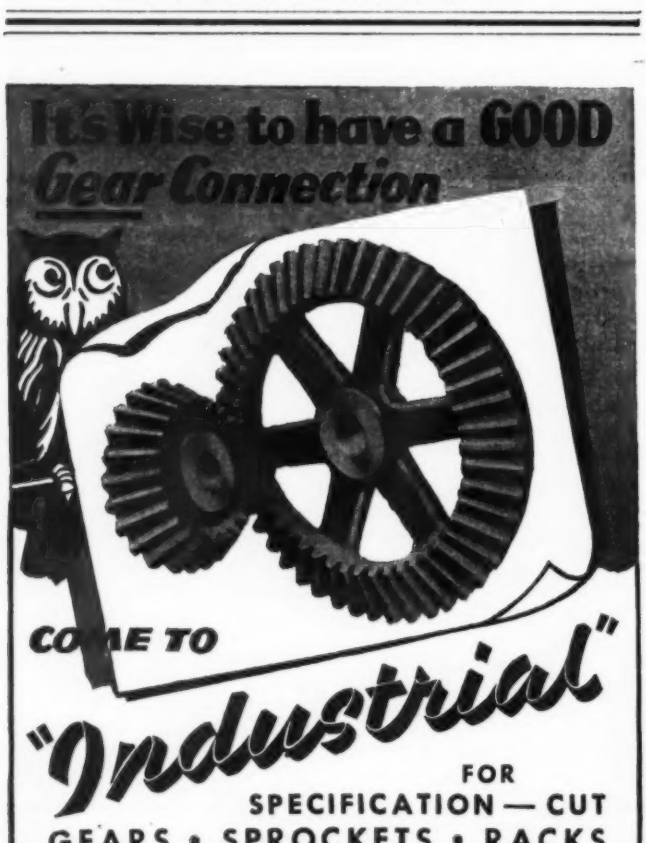

FOR
SPECIFICATION — CUT
GEARS • SPROCKETS • RACKS
HIGHEST QUALITY • GREATEST PRECISION
Write for Gear Catalog and Engineering Manual

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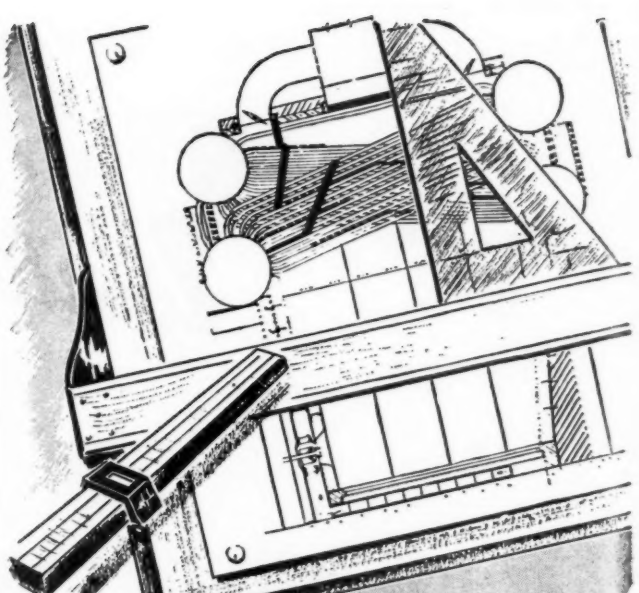


Baffles that are .... *designed* right .... *built* right

● The first requirement of a baffle installation is good engineering—a design that takes fullest advantage of the boiler and fuel-burning equipment. Do you get this in a Beco-Turner installation? For the answer look at the operating records—in improved performance and fuel economy of boilers where existing baffles have been replaced by new Beco-Turner baffles.

You need no better reason for installing Beco-Turner baffles than the engineering "know how" attested by the outstanding results delivered in these plants . . . but you have still another reason: If you look farther into the Beco-Turner record, you will find that Beco-Turner construction is as advanced as Beco-Turner engineering.

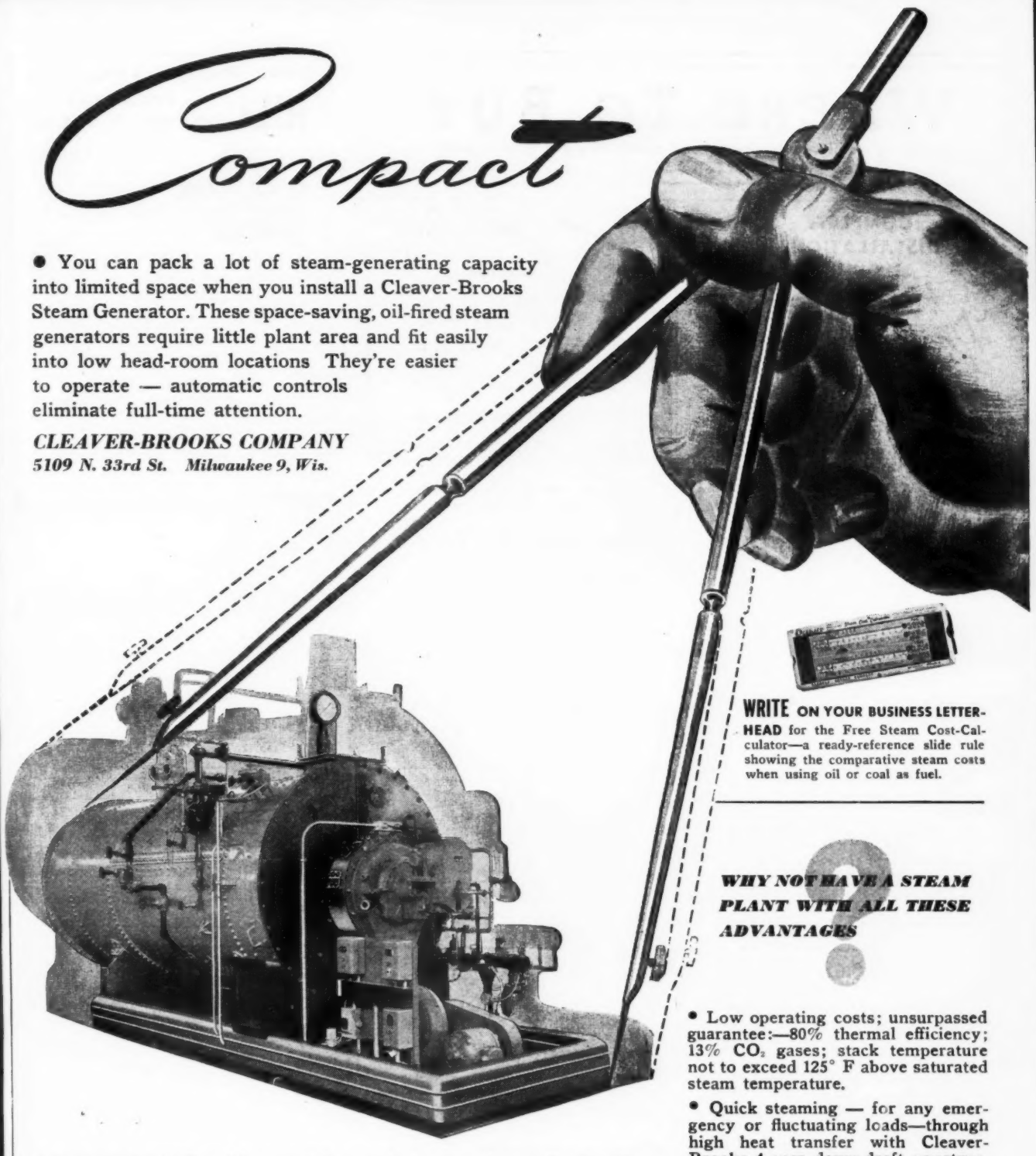
Beco-Turner baffles are cast in place. As a result, it is never necessary to compromise design considerations to structural limitations. Expansion joints (an exclusive feature) prevent cracks—keep these baffles absolutely gas tight throughout their long life. Send blueprints showing your present design or contemplated new boilers for our recommendations.

PLIBRICO JOINTLESS FIREBRICK CO.
1818 Kingsbury St., Chicago 14, Illinois

Compact

• You can pack a lot of steam-generating capacity into limited space when you install a Cleaver-Brooks Steam Generator. These space-saving, oil-fired steam generators require little plant area and fit easily into low head-room locations They're easier to operate — automatic controls eliminate full-time attention.

CLEAVER-BROOKS COMPANY
5109 N. 33rd St. Milwaukee 9, Wis.



WRITE ON YOUR BUSINESS LETTERHEAD for the Free Steam Cost-Calculator—a ready-reference slide rule showing the comparative steam costs when using oil or coal as fuel.

WHY NOT HAVE A STEAM PLANT WITH ALL THESE ADVANTAGES

• A steam-plant tailored for your job. Cleaver-Brooks analyzes your load conditions, space and equipment arrangements, future growth needs, puts unit into initial operation, instructs as to operation, care and maintenance.

• One source and one responsibility for the complete generator—Cleaver-Brooks Factory-finished and tested —a fully "packaged" unit meeting all code requirements.

• Fast installation. No special foundation needed. Within 24 hours after arrival, your Cleaver-Brooks Steam Generator can be in operation.

• No smoke-stack required; simple roof-high vent exhausts combustion gases.

• Saves space, uses less plant area, fits into low head-room locations.

• Oil-firing eliminates smoke, ashes, clinkers, and messy boiler-room conditions.

• Low operating costs; unsurpassed guarantee:—80% thermal efficiency; 13% CO_2 gases; stack temperature not to exceed 125° F above saturated steam temperature.

• Quick steaming — for any emergency or fluctuating loads—through high heat transfer with Cleaver-Brooks 4-pass down-draft construction and integral oil-burner.

• Designed for utmost convenience of operator—all controls may be operated from front of boiler. A factory engineer puts unit into initial operation, and trains your employees in operation, care and maintenance.

• Full size range is available — 22 models in sizes from 15 to 500 hp., at steam pressures from 15 to 200 lbs. p.s.i. Write for bulletin and complete information.

Cleaver-Brooks
STEAM GENERATORS

WHERE TO BUY

Featuring additional products and specialties for power plants

COMPLETE INSTALLATIONS ANYWHERE OF

Diesel and Steam Generating Units

3 to 5,000 K.W. or larger

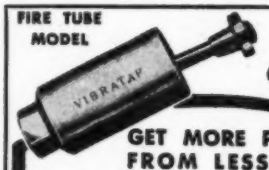
CONSULT US REGARDING YOUR REQUIREMENTS

ARNESSEN ELECTRIC COMPANY

116 Broad St. N. Y. C. 4, N. Y.

Bowling Green 9-8542

FIRE TUBE MODEL



QUICK TUBE CLEANING

GET MORE POWER FROM LESS FUEL

VIBRATAP CLEANER

For fire tube and water tube boilers. Rapid vibration quickly breaks scale's grip on tubes. Fast, perfect cleaning—down goes fuel expense! Just try one! Also ask about our Mohawk power-driven Soot Scraper.

BRUNT EQUIPMENT CO.

60 S. DIVISION ST. • BUFFALO, N. Y.

End Pump Troubles!

HILL IMPROVED PUMP VALVES

• The valve with the renewable feature restores old pumps to original efficiency. Constant contact is maintained over the full bearing surface no matter in what position the valve rotates because of the exclusive HILL design. Efficient, durable, economical, accurate. Send today for bulletin that tells how to get better pump performance.

HILL PUMP VALVE CO.

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"MONO"

BOILER BAFFLES

HIGH TEMPERATURE

Refractory Cements

SANFORD C. SMITH REFRACTORIES, INC.

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Power Plants

Steam - Diesel - Hydro

Design - Construction - Test - Valuation

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The Real Value

of placing your unusual problem in the hands of a competent consultant eliminates the elements of chance and uncertainty from the problem and provides real facts upon which to base decisions.

PUBLIC UTILITY ENGINEERING & SERVICE CORPORATION

CONSULTING ENGINEERS

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231 S. LaSalle St., Chicago (4), Ill.

JOHN A. STEVENS, Inc.

Established 1909

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Power Plants Paper Mills

Dye Houses Surveys

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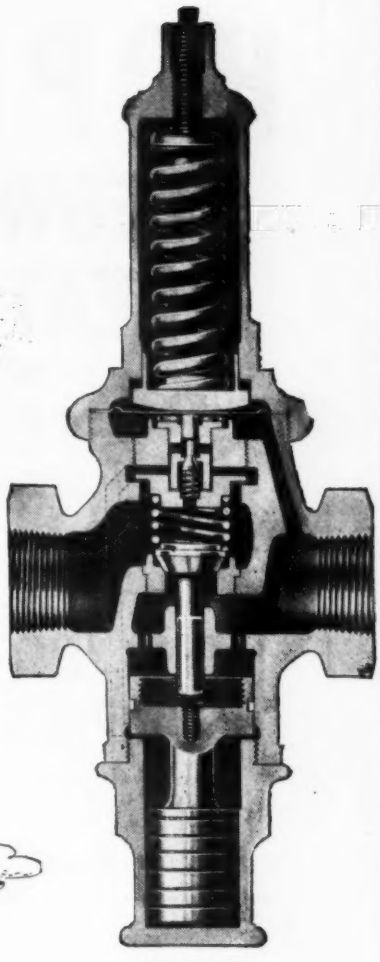
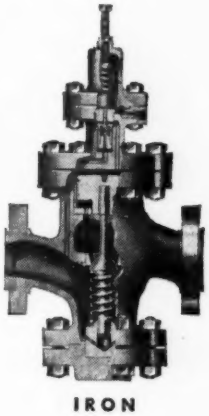
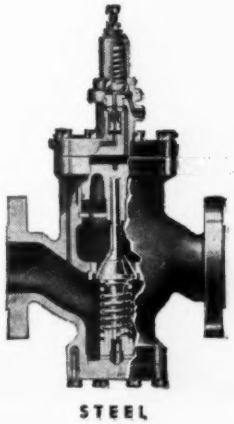
Pointing the Way to Sustained Production Schedules


BRONZE


IRON


STEEL

To reduce waste, cut maintenance costs and save money, use Masoneilan No. 11 pressure regulators. Once installed, these sturdy, dependable reducing valves provide accurate regulation of steam pressure year after year without further attention.

Such advantages as wide range of adjustment without charge of spring . . . extreme sensitivity . . . unaffected by fluctuating initial pressure or demand—insure accuracy of control and low maintenance costs.

They are available with bronze, iron or steel bodies. Bronze M.W.P. 250 psi, ranges between 5 and 225 psi; Iron M.W.P. 250 psi, ranges between 10 and 225 psi; steel M.W.P. 300, 600 psi, ranges between 35 and 450 psi. Catalog No. 73 gives the entire story. Write for your copy.

MASON-NEILAN REGULATOR COMPANY

1186 ADAMS ST., BOSTON 24, MASS., U. S. A.

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Pittsburgh Tulsa Los Angeles Toledo Atlanta San Francisco
Mason Regulator Co. of Canada, Ltd., Montreal, Canada

MASONEILAN

HOPPES
FEEDWATER HEATERS

Deaerating and Non-Deaerating

Write for Bulletin

THE HOPPES MFG. CO.

Established 1881

SPRINGFIELD OHIO

Pennsylvania Single-Stage Roller Bearing Compressor

PENNSYLVANIA SINGLE-STAGE DOUBLE ACTING TIMKEN ROLLER MAIN BEARING COMPRESSOR

Designed for heavy duty continuous service.

Furnished in sizes from 5 to 125 hp. for pressures from 15 to 150 lb.

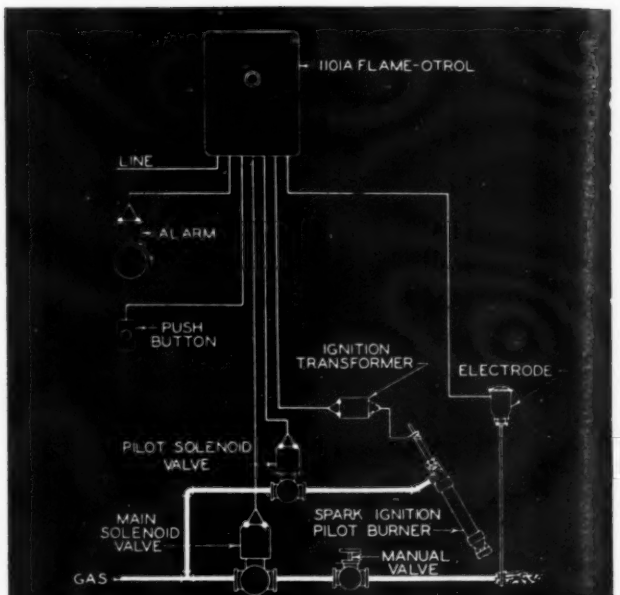
Equipped with trouble-free *Air Cushion* valves.

All Metal construction regulating mechanism completely eliminates frequent source trouble, replacements or repairs rarely required.

Overhead motor mounting illustrated provides compact unit occupying minimum floor space, reduces cost foundation.

PPC PENNSYLVANIA PUMP & COMPRESSOR CO.

BUSHKILL PARK ROAD, EASTON, PENNA.

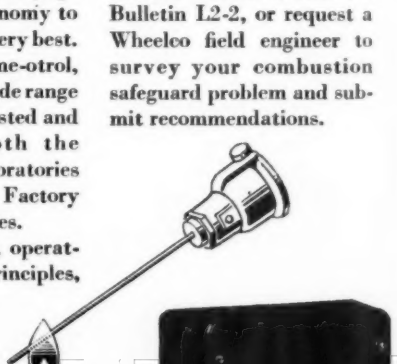


Time-proved Flame-otrol Combustion Safeguard

IN safeguarding life, property and production schedules against explosion of fuel-fired heating or industrial heat-process equipment, it is poor economy to install any but the very best.

The Wheelco Flame-otrol, time-proved by a wide range of installations, is listed and approved by both the Underwriters' Laboratories and the Associated Factory Mutual Laboratories.

Fully automatic, operating on electronic principles, the Flame-otrol shuts off all fuel to the burner, thereby preventing fuel and fume accumulation in the combustion chamber. Ask for Bulletin L2-2, or request a Wheelco field engineer to survey your combustion safeguard problem and submit recommendations.



WHEELCO CONTROLS

A complete line, including Flame-otrol combustion safe-guards . . . Capacitrol pyrometer controllers . . . Indicating pyrometers . . . Proportioning controls . . . Program control . . . and a wide range of accessories.

WHEELCO INSTRUMENTS COMPANY

863 W. Harrison St. Chicago 7, Ill.

WHEELCO

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EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

UNDISPLAYED RATE:

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15 cents a word, minimum charge $3.00.
(See ¶ on Box Numbers.)
POSITIONS WANTED (full or part-time individual salaried employment only), ½ the above rates.
PROPOSALS, 75 cents a line an insertion.

INFORMATION:

BOX NUMBERS in care of any of our New York, Chicago or San Francisco offices count 10 words additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED RATE:

The advertising rate is $7.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches —to a page.

NEW ADVERTISEMENTS received by March 15th will appear in the April issue, subject to limitations of space available.

WANTED

MASTER MECHANIC

New York area. Food Plant.
State age, experience, salary.

P-798, Power
330 West 42nd St., New York 18, N. Y.

POSITIONS VACANT

ENGINEER-EDITOR. M.E. graduate. Prefer man about 40 with some practical engineering experience. Position consists of preparing booklets dealing with lubrication of various types of machinery. Permanent position. Major oil company. Location New York City. Starting salary $5,000. Give full details as to age, education and experience. P-791, Power, 330 W. 42nd St., New York 18, N. Y.

ENGINEER. Staff assistant on diesel engines. Must be M.E. graduate thoroughly experienced in the engineering and operational phases. Location New York City. Salary $6,000. Replies must state complete details as to age, education and experience. P-792, Power, 330 W. 42nd St., New York 18, N. Y.

WANTED: EXPERIENCED draftsmen, preferably familiar with beet sugar factory design. Duration of project approximately one year. Location middle west. Give particulars as to education, experience, military status. State salary expected. References. Must have U.S.E.S. clearance. P-805, Power, 520 N. Michigan Ave., Chicago 11, Ill.

FIRE PROTECTION Engineers and inspectors. Technical graduates, especially chemical and electrical; civil, mechanical, metallurgical also considered. Inspect and consult industrial plants to prevent fires, explosions, and other casualties. Considerable travel and report writing; interesting work offering permanency. Engineering experience necessary. Salary open. Well-known national organization with openings at Cleveland, Chicago, and other district centers. Men under 30 years of age cannot be considered. Please send a photograph when applying. P-806, Power, 330 W. 42nd St., New York 18, N. Y.

APPLICATION ENGINEER—Wanted by internationally known manufacturer. Must have M.E. degree with experience in Air Conditioning and Refrigeration. Opportunity to enter sales in field. Position is essential with permanent future. State qualifications, age, nationality. P-807, Power, 330 W. 42nd St., New York 18, N. Y.

MECHANICAL DRAFTSMEN and engineers experienced in steam power plant design and detailing work. State age, experience and salary desired. WMC rules apply. Write P-808, Power, 520 N. Michigan Ave., Chicago 11, Ill.

WANTED—Mechanical Engineering graduate for permanent position in results department of a large steam generating station. Station is operated by a public utility corporation located in the East. Statement of availability is required. Write P-809, Power, 330 W. 42nd St., New York 18, N. Y.

EMPLOYMENT SERVICE

SALARIED POSITIONS — This advertising service of 35 years recognized standing negotiates for high salaried supervisory technical and executive positions. Procedure will be individualized to your personal requirements and will not conflict with Manpower Commission. Retaining fee protected by refund provision. Identity covered and present position protected. Send for details. R. W. Bixby, Inc., 270 Delaware Bldg., Buffalo 2, N. Y.

(Continued on page 330)

EXPERIENCED ENGINEERS for GAS TURBINE DEVELOPMENT

The Elliott Company, Research and Development Department offers unusual opportunities for work in this new field of power development. Permanent jobs and several key positions are open to:

COMBUSTION ENGINEERS **TEST ENGINEERS**
PROCESS ENGINEERS **CHECKERS**
DESIGN ENGINEERS **DETAILERS**

This is war work with a future.
Write giving full details.
All replies confidential.

ELLIOTT COMPANY

Research & Development Dept.
JEANNETTE, PA.

CHEMISTS ENGINEERS PHYSICISTS

Men interested in careers in industrial research are urged to write us giving details of training and experience—Essential work with promising postwar future offering opportunities for professional growth.

Battelle Memorial Institute

Columbus 1, Ohio

WANTED

Powerhouse Engineer

High pressure plant, 12,000 KW load, attached to large chemical manufacturing plant in Ohio. Must be technically competent and know how to handle substantial organization. Give full details in first letter. Address P-803, Power, 520 N. Michigan Avenue, Chicago, Ill.

WANTED

ENGINEER

For large food manufacturing company. Good general knowledge of the sugar industry and food processing work. Excellent opportunity. Steady, post-war position. State age, experience, salary, etc.

P-799, Power
330 West 42nd St., New York 18, N. Y.

WANTED

Power Plant Operating Engineer

Experience must qualify him to take full charge of a 1500 kw turbine-generator plant located in Michigan. Give age, detailed list of experience, education, and salary wanted in first letter. References will not be contacted until after interview.

P-804, Power
520 North Michigan Ave., Chicago 11, Ill.

POSITION VACANT

By long established contracting concern for man familiar with boiler erection, refractory work and fire brick repair work, with experience in contact and estimating. Please state experience, age, draft status and salary expected. This position is permanent with opportunity for advancement for right man.

P-814, Power
330 W. 42nd St., New York 18, N. Y.

(Continued from page 229)

POSITIONS WANTED

STEAM POWER Plant engineer with 20 years experience as operating and chief engineer of small and medium size power houses. Sober and dependable. Good references. PW-795, Power, 330 W. 42nd St., New York 18, N. Y.

MAKE YOUR automatic control system complete by obtaining the services of a combustion engineer who is a specialist in boiler house instrumentation. Eight years experience in three modern steam plants having a total of 42 boilers, the combined capacity of which is 4,200,000 lbs. steam per hour. I will solve your toughest control problems in the most practical manner. Excellent references. PW-810, Power, 520 N. Michigan Ave., Chicago 11, Ill.

SALESMAN WANTED

ENGINEER with pump or steam turbine experience for saleswork at home office. Also selling opportunities in Philadelphia, Detroit and other cities open to active salesmen now selling industrial power equipment. Dean Hill Pump Co., 4000 E. 16th St., Indianapolis 7, Ind.

SALESMAN AVAILABLE

LATIN AMERICAN US graduate engineer 24 years experience in one of the most varied fields of power production and utilization desires position covering Latin American territory as traveling engineer for American manufacturer on salary or salary and commission. Age 45. SA-782, Power, 330 W. 42nd St., New York 18, N. Y.

FOR SALE

PLANIMETER 10 sq. in. capacity. Over all length 10 in. Precise and like new, with case. Price $50. FS-811, Power, 330 W. 42nd St., New York 18, N. Y.

BUSINESS OPPORTUNITY

WANTED—Manufacturers agent is seeking a low-cost patented device which has novelty and can be manufactured to advantage. BO-812, Power, 520 N. Michigan Ave., Chicago 11, Ill.

MANUFACTURER'S REPRESENTATIVE WANTED

A sales engineering organization experienced in steam specialties and equipment for power plants, process industries and the marine field. New York City territory. A well established and profitable line represented in New York for over 20 years. Arrangements will be made direct with the manufacturer. Address

RW-813, Power
520 North Michigan Ave., Chicago 11, Ill.

ARE YOU REPRESENTED IN NEW ENGLAND?

Established New England Firm handling equipment for power and manufacturing plants and marine trade desires additional Line.

RA-800, Power
330 W. 42nd St., New York 18, N. Y.

Manufacturers Representatives

Want account for Pennsylvania, N. J., Delaware, Maryland. Wide acquaintance twenty years experience light and heavy machinery, instruments mech. and elec. engineers. Proven sales record. Office in Philadelphia. Prefer machinery for process industrial and power plant equipment.

RA-801, Power
330 W. 42nd St., New York 18, N. Y.

SALES ENGINEER

Offers to represent good line of power plant equipment on exclusive agency basis.

Has thorough experience with steam and power generating equipment and accessories. Good sales record and contacts in Metropolitan New York area.

RA-787, Power
330 W. 42nd St., New York 18, N. Y.

NEW PRODUCTS WANTED

By 40 Year Old Manufacturer of

POWER PLANT SPECIALTIES

This manufacturer is an acknowledged leader in his field, has an exceptionally strong financial position and has a nationwide sales organization. He is interested in adding to his line of steam power plant specialties several new products with good postwar sales possibilities. He has a research organization capable of thoroughly testing new products and doing any additional development work found necessary. Write to

WITTE & BURDEN • ADVERTISING
5757 Cass Ave. Detroit 2, Mich.

COAL STRIPPING CONTRACT WANTED

Experienced stripping contractor having, due to exhaustion of present mine, organization and equipment available, desires to produce strip coal and deliver on railroad cars or truck to plant storage pile for utility company or large industrial consumer, thereby insuring it low-cost dependable fuel supply. Will enter into long-term contract and furnish highest references.

WW-786, Power
520 North Michigan Ave., Chicago 11, Ill.

Don't forget the

BOX NUMBER

When answering the classified advertisements in this magazine don't forget to put the box number on your envelope. It's our only means of identifying the advertisement you are answering.

WANTED

WANTED TO BUY FOR ST. LUKE'S HOSPITAL, CHICAGO, ILLINOIS

Cylinder Complete with Cylinder Head, Piston and Valves for 17 x 17 Fleming 4-Valve Engine

Manufactured by HARRISBURG FOUNDRY AND MACHINE COMPANY

Length of Cylinder Casting: Flange to Flange 32 inches

Please reply to:

VERN E. ALDEN, *Engineers*
120 South LaSalle Street Chicago 3, Illinois

WE BUY FOR C A $ H

SEND LISTINGS AND PRICES
TRANSFORMERS CONTROLS
MOTORS MOTOR GEN. SETS
AIR OIL CIRCUIT BREAKERS

POWER EQUIPMENT COMPANY
156 Andrews St., Rochester 4, N. Y.
Telephone Main 568 or 569

WANTED

350 to 400 KVA Generator connected to a steam turbine for 115# steam pressure and 10# back pressure. Give serial number.

Evangeline Pepper and Food Products
ST. MARTINVILLE, LA., U. S. A.

New SEARCHLIGHT Advertisements

received by March 15th will appear in the April issue, subject to space limitations.

Departmental Staff
POWER
330 W. 42nd St., New York 18, N. Y.

HI-LIGHTS OF *Hemphill* VALUES!

YOU get the same careful scrutiny of equipment VALUES from the graduate Electrical Engineers who head our staff as you would from your own. That's because we tie up our own money FIRST in such equipment. The same men also watch any needed rebuilding and operating tests before shipment. Is it any wonder then, that with men who know EQUIPMENT values best — it's "Hemphill for Power"?

Engineered Supervision

Graduate Electrical Engineers supervise the value of all equipment we buy or control. These men not only judge equipment before we take over—but before YOU take over, after any needed rebuilding.

The Hemphill SEAL OF QUALITY GUARANTEES ENGINEERED RECONDITIONING

MOTORS—3 PHASE 60 CYCLE

1—300 HP, 900 RPM, Lincoln, 440 volt, slip ring.
1—400 HP, 1200 RPM, 220 volt, Westinghouse squirrel cage.
1—350 HP, 300 RPM, 440 volt, General Electric slip ring.
1—200 HP, 600 RPM, 2200 volt, G. E., sl. rg.
1—150 HP, 1800 RPM, 440 volt, General Electric, squirrel cage.
1—150 HP, 1750 RPM, Westinghouse, sl. rg.
2—150 HP, 1200 RPM, 2200 volt, Westinghouse, squirrel cage.
1—150 HP, 400 RPM, 440 volt, General Electric, squirrel cage.
1—125 KVA, 900 RPM, 220 volt, Westinghouse, synchronous.
1—100 HP, 1800 RPM, 440 volt, General Electric, squirrel cage.
3—100 HP, 720 RPM, 440 volt, G.E., sl. rg.
1—100 HP, 600 RPM, 440 volt, G.E., sl. rg.
2—100 HP, 450 RPM, 440 volt, G.E., sq. cg.
1— 90 HP, RPM, 550 volt, Cr. Whir. sq. cg.
1— 75 HP, 900 RPM, 4000 volt, Elec. Mach. syn.
1— 75 HP, 720 RPM, 440 volt, Westghse., slip ring.
1— 75 HP, 1200 RPM, G.E., sl. rg.
2— 75 HP, 900 RPM, G.E., sl. rg.
1— 60 HP, 1200 RPM, 220 volt, General Electric, slip ring.
1— 50 HP, 900 RPM, 440 volt, G.E., sl. rg.
1— 50 HP, 900 RPM, 440 volt, G.E., sq. cg.

MOTORS—D.C. 230 VOLTS

2—450 HP, G.E., 400 RPM, Type MPL Form 1-F.
1—250 HP, 760 RPM, Electro Dynamic.
1—150 HP, 750 RPM, Electro Dynamic.
1—150 HP, 500 RPM, General Electric, type MPC.
1—125 HP, 600 RPM, Westinghouse, SK.
1—100 HP, G.E., 575 RPM.
1—100 HP, 625 RPM, G.E.
1— 80 HP, Crocker-Wheeler, 600 RPM, Type CMC.
1— 75 HP, G.E., 575 RPM, Type C, Sprague; with spare armature.

MOTORS—D.C. 230 VOLTS (Con't)

8—50 HP, Crocker-Wheeler, 700 RPM, Type CM.
1—50 HP, 700 RPM, Crocker-Wheeler.
1—30 HP, 750 RPM, G.E., Type RC.
1—30 HP, G.E., 750 RPM, Type RC-14, Form A.
1—30 HP, G.E., 1100 RPM, Type RC-31B, Form A-21.
1—35 HP, G.E., 650 RPM, Type RC-15.
1—30 HP, G.E., 625 RPM, Type C.
1—25 HP, Westghse., 600 RPM, Type SK.
2—25 HP, G.E., 775 RPM, Type RC-13.
1—20 HP, G.E., 800 RPM, Type RC-13, Form A.
1—15 HP, G.E., 800 RPM, Type RC-11.

MOTORS—VARIABLE SPEED 230 VOLTS

1—90 HP, 470/940 RPM, General Electric.
1—75 HP, 525/1575 RPM, Electro Dynamic.
1—60 HP, 500/1000 RPM, Diehl.
1—30 HP, 225/900 RPM, Crocker Wheeler.
1—30 HP, 400/1200 RPM, General Electric.
1—25 HP, Westinghouse, 650/2200 RPM, Type SK-110L.
2—25 HP, 300/900 RPM, Electro Dynamic.
1—15 HP, 300/1200 RPM, G.E.
1—13/18 HP, 350/1200 RPM, Electro Dynamic.
3—11½ HP, 500/1500 RPM, Westinghouse.
1—10 HP, 400/1600 RPM, Westinghouse.
1— 5 HP, 600/1200 RPM, General Electric.
1— 5 HP, 450/1800 RPM, Crocker Wheeler.
1— 5 HP, 400/1600 RPM, Diehl.
1— 5 HP, 225/900 RPM, Electro Dynamic.

MOTOR GENERATOR SETS

1—750 KW, 250 volt, Allis Chalmers, synchronous.
1— 75 KW, 125 volt, General Electric, squirrel cage.
1— 20 KW, 600 volt, General Electric, squirrel cage induction motor.
2— 15 KW, 250 volt, General Electric, squirrel cage.

TURBO GENERATORS

600 KW, Terry dual bleeder condensing Turbine only.
1—500 KW, G.E., 3 ph., 60 cy., 430 volt, bleeder.
1—375 KVA, Westghse., non-condensing.
1—300 KW, G.E., 3 ph., 60 cy., 220 v. con.
1—200 KW, G.E., 3 ph., 60 cy., 220 v. cond.
1— 30 KW, 135 volt, Allis-Chalmers non-condenser.

ALTERNATORS

1—625 KVA, 3600 RPM, 600 volt, G.E.
1—250 KVA, 720 RPM, 2300 volt, G.E.
1—200 KVA, 3600 RPM, 240 volt, Allis-Chal.
1—62½ KVA, 3600 RPM, 220 volt, Allis Chal.

TRANSFORMERS

2—400 KVA, G.E., 4156-250/480 v., Scott taps.
3—300 KVA, Pittsburgh 7800/440 volts.
3—150 KVA, G.E., 33000/2300/4000 Y.
2—100 KVA, General Electric 2300/230/440 volt.
3—100 KVA, Westinghouse, 11,430/250 volts.
3—100 KVA, Westinghouse, 13200/250 volts.
3— 75 KVA, Westinghouse, 2200/230/110 volt.
3— 75 KVA, G.E., 13,500-750/440 volts.
1— 75 KVA, G.E., 3 phase, 4156Y—120/208Y.
2— 50 KVA, Pbgh. 7500/15000 volts-110/220 volts.
2— 15 KVA, G.E., 2300-115/230 volts.
2—100 KVA, G.E., 2400/240/480.

GASOLINE DRIVEN DC GENERATOR SETS

2—25 KW, 125 volt.
1—30 KW, 125 volt.

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Changing your POWER PLANT SET-UP?

. . . SEE BELYEA!

Yes—we exchange machinery, and make liberal allowance, too. Or we will SELL you Belyea Re-Nu-Bilt Equipment, GUARANTEED against electrical and mechanical defects. We've 36 years of experience behind us, and will give you professional engineering service without obligation.

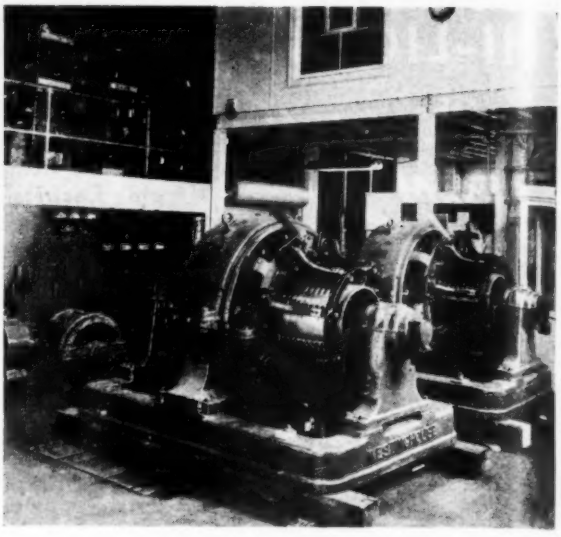

Photo above shows 2—1000 KW 600 volt., 60 cycle rotary converters which have been completely Belyea Re-Nu-Bilt. Once used for Railway service, these units now help to build ships.

Solve your Power Plant problems with Belyea Equipment . .

MOTOR GENERATOR SETS

3 Phase 60 Cycle

1—1500 KW G.E., 250/275 V. D.C. to 2100 H.P., 2300 V.
1—1000 KW G.E., 250/275 V. D.C. to 1400 H.P., 2300/4150 V.
1—1000 KW Whse., 600 V. D.C. to 2000 KVA, 2200 volt with exciter.
1—750 KW Whse., 275 V. D.C. to 1100 H.P., 220 volt with exciter.
1—500 KVA—330 KW—220/440 V. A.C. Gen. to 500 H.P.—230 V. D.C. Motor.
1—500 KW G.E., 600 V. D.C. to 700 H.P. 13200/6600 V.
1—400 KW G.E., 250/275 V. D.C. to 650 H.P. 2300 V.
1—300 KW G.E., 600 V. D.C. to 435 KVA, 2300 V.
1—250 KW G.E., 275 V. D.C. to 435 KVA, 2300 V.
1—200 KW G.E., 125 V. D.C. to 300 KVA, 440 V. Syn. Motor with exciter.
1—105 KW G.E., 70 V. D.C. to 160 H.P., 2300 V. Syn.
1—75 KW G.E., 125 V. D.C. to 120 H.P., sq. cg., 2300/4000 V.
1—50 KW G.E., CD, 125 V. D.C. to 75 H.P., sq. cg., 2390/4000 V.
2—20 KW G.E. 250 V. DC to 30 H.P., 440 V. induction motor.

3 Phase 25 Cycle

1—25 KW G.E., 125 V. D.C. to 35 H.P., 360 V. Motor.
1—75 KW Whse., 125 V. D.C. to 110 H.P., 440 V. Motor.
1—250 KW G.E., 250 V. D.C. to 285 KVA, 6600 V. Motor.

TURBO GENERATOR SETS

1—500 KW Whse. 625 KVA, 440 V. 3 ph. 60 cy. 3600 RPM with Parsons 145/175 lb. cond. turbine complete with jet cond. and access.
1—75 KW Ridgeway 250 V. D.C. with Terry turbine 180 lbs. pressure with 12 lb. bk. pres., 2000 RPM.

FREQUENCY CHANGER

1—75 KW G.E., with 94 Kva .8 pf 240 volt type ATB, 3 ph. 62½ cycle gen. and 125 HP 440 volt 25 cycle Ind. motor.
1—1000 KW G.E. with 1250 Kva, .8 p.f. AQB 2300 volt 2 phase (can be changed—800 KW 3 phase) 58.3 cycle gen. and 1400 HP .8 p.f. 440/2200 volt ATI 3 phase 25 cycle motor and exciter.

A.C. MOTORS

3 Phase 60 Cycle

SLIP RING

Qu.	HP	Make	Volts	RPM	Desc.
2	100	G.E.	2200	575	IM
1	100	G.E.	550	685	MTC-5552
1	100	G.E.	550	720	IM
1	100	G.E.	220	1750	IM
1	150	Whse.	2200	1200	CW
3	250	Whse.	440/2300	450	CW
1	250	G.E.	4000	257	MT-424Y
1	350	G.E.	4000/2200	253	MT-442Y
1	400	G.E.	2200	252	IP
1	400	A.-C.	2300	505	ANY
1	450	Whse.	2200	875	CW
1	600	G.E.	550	220	MT
1	800	A.-C.	440	885	ANY
1	1200	C. W.	2300	237	801Q

3 Phase 25 cycle

1	75	Al. Ch.	440	750	ANY
1	125	G.E.	440	730	KT
1	150	G.E.	440	500	IM
1	200	G.E.	440	242	Sl. Rg.
1	300	G.E.	440	290	Sl. Rg.
1	390	G.E.	6600	750	ATI
1	1400	G.E.	2300	500	ATI

SQUIRREL CAGE

Qu.	HP	Make	Volts	RPM	Desc.
1	100	G.E.	2300	450	IK Vert.
1	125	Whse.	550	1140	CS
1	150	Whse.	550	400	CS-594A
2	175/112	G.E.	440	900/720	IK
1	200	G.E.	2200	490	IK
1	200	G.E.	550	580	IK
1	200	G.E.	440	900	IK
1	300	G.E.	440	900	IK
1	300	Whse.	550	580	CS
1	100	West.	2200	880	CS

SYNCHRONOUS

Qu.	HP	Make	Volts	RPM	Desc.
1	125	Whse.	2200	1800	
1	150	Whse.	4000	1800	dir. con. exctr.
1	600	Al. Ch.	2300	720	
2	2100	G.E.	2200/4400	514	ATI

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Volts	Speed	Desc.
1	750	G.E.	220/440	900	ATI
1	900	G.E.	2200/6600	1200	TS
1	1000	G.E.	2300/4100	900	ATI
1	3000	Al. Ch.	2300	900	
1	5000	Whse.	2300/4000	900	

ROTARY CONVERTERS

3 Phase 60 Cycle

Qu.	KW	Make	Speed	DC V.	Trans. V.
1	1500	Whse.	720	600	2300
1	1500	Whse.	600	600	11500
1	1250	G.E.	720	250	2300
1	1000	Whse.	720	250	22000
1	1000	G.E.	900	600	13200
1	1000	Whse.	900	600	11000
2	750	G.E.	1200	600	2300
1	750	Whse.	720	250	6600/2300
1	500	Whse.	1200	600	13200/2300
2	375	G.E.	1200	250	6600/2300
2	300	G.E.	1200	600	2300

3 Phase, 25 Cycle Booster Type

2	1500	G.E.	500/225/275/13200/6600
1	500	G.E.	750/225/275/13200/6600

All units can be furnished with AC and DC controls

D.C. MOTORS

Qu.	HP	Make	Type	Volts	Speed
2	1250	G.E.	MPC	500	180
1	1200	Whse.	Int.	600	600/720
1	1200	G.E.	MPC	600	450
1	800	G.E.	MPC	550	600
2	625	G.E.	MPC	500	130
1	500	Whse.	Int.	250	250/720
1	500	G.E.	MPC	230	900
1	350	G.E.	MPC	230	450
1	300	G.E.	MPC	230	275/550
1	250	Al. Ch.		230	525
1	250	G.E.	C	230	375
2	200	Whse.	SK	230	400
1	175	Whse.	SK	230	150/525
1	150	G.E.	MPC	230	250/450
2	130	Cr. Wh.	CMC-65H	550	1200
2	125	G.E.	CO-1832	230	625
1	100/150	Whse.	SK-200	550	600
1	100	G.E.	LC-50	230	1200
1	100	Whse.	SK-180	230	600
1	100	G.E.	RC-38	230	600
1	75/100	Whse.	SK-183	230	450/900
1	50/100	G.E.	MPC	230	225/450
2	75	Whse.	SK-188	230	500/1000
1	75	G.E.	C	230	500/1000
1	60	El. Dy.	258	230	525/1050
1	60	Al. Ch.	E-131	110	1750
1	50/60	Cr. Wh.	CMC-65H	230	500/1000
1	50	G.E.	RC-19	230	400/1200
1	50	Cr. Wh.	CMC-80H	230	380/750
1	15/50	Cr. Wh.	CMC-81H	230	300/900

SUCCESSFUL OPERATION GUARANTEED
Quality without Question

BELYEA CO., INC.

Main Office and Shop
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RE NU BILT BELYEA MOTORS

Below BERGER OFFERS

Rebuilt and Sold with a Standard New Guarantee

ONLY PARTIAL LIST

TRANSFORMERS

1—200 KVA GE, type H.K. 2300/115/230 volts, 1 PH, 60 cy.
2—200 KVA GE, type H Form VD 4800/2400/480 volts. 1 PH. 25 cy.
1—100 KVA GE, type H Form KDD 11000/2600 volt. 1 PH. 60 cy.
2—75 KVA West. type S.K. 1 ph. 25 cy. 60000 volts Prim—6900/2300 volts secondary.
3—75 KVA Gen. Elect. K.S. 1 ph. 60 cy. 2300/115/230 volts.

OTHER SIZES VOLTAGE AND CYCLES AVAILABLE

ALTERNATORS

250 K.W.—(312 KVA) Gen.-Elect., Type A.T.I.—2300/4600 volt, 60 cycle 150 R.P.M. P. F. .08 with belted exciter.
240 KW, 8 PF Electric Machinery, 4600 volts, 60 cycle, 3 phase, 450 R.P.M. with direct connected exciter.
200 K.W. Westh. Unity Power Factor, 3 PH, 60 cyc. 220/440 900 R.P.M. with direct connected exciter.
150 KVA Westinghouse, 3 phase, 60 cycle, 2300 volts, 600 R.P.M. Revolving field with direct connected exciter.
150 KVA Gen. Elec. Type ATB form D, 60, 3 ph., 220/440 600 with Rev. Field, and built in Exc.

MOTOR GENERATOR SETS

Western Elect. 1000 Amps—40 volts direct con. to either AC or DC 580 RPM Motor.

FREQUENCY CHANGERS

30 K.V.A. Gen. Elect. type I.T.T. frame 526 P.F. 08—220/440 volts 3 Ph. 60 cy. to 240 volts 120 cycle Motor KT frame 526—3 Ph. 60 cy. 220/440 volts 1800 RPM.

ALL SIZES VOLTAGES AND CYCLES

3 ph. 25 cy. Motors

H.P.	Make		Type	Speed	Volts
350	Gen. Elec.	Sl. Rg. 3 Brg	I	375	400
200	Lincoln	S. R	I. X. W.	500	440
150	Gen. Elec.	Sl. Rg.	I Form M	500	2200
100	Wagner	Sl. Rg.	BR	750	220/440
50	Wagner	Sq. C.		500	220/440

3 ph. 60 cy. A. C. Motors

H.P.	Make		Type	Speed	Volts
200	West.	Syn.-Dir. Con. Ex.	P. F. 08	900	220/440
200	Gen. Elec.	Syn.	ATI	514	4000/2300
200	Weghse.	Syn	Dir. Con. Exc.	600	2300
150	Burke	Sq. Cg.	3 Bg. 2 Ph.	900	220/440
125	Gen. Elec.	Sq. Cg.	I. K. Vert.	720	220

230 Volt D. C. Motors

H.P.	Make	Type	Speed
85	Gen. Elec.	Vert. Comp. Wound	700
75	Crocker Wh.	CCM25JA	1700
60	Sprague	D — Comp. Wound	625
40	Fair. Morse	Ball BRG. Vert. Comp.	1740

125 Volt D. C. Motors

H.P.	Make	Type	Speed
60	Allis Chalmers	FB131-Comp.	1755

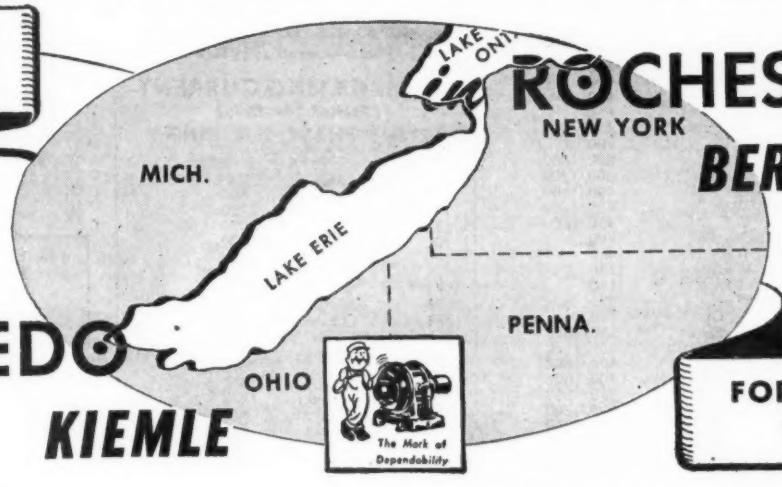
550 Volt D. C. Motors

H.P.	Make	Type	Speed
35	West.	SK150 Shunt Int.	850

D. C. GENERATORS

150 KW Western Elec. 3 brg. 3 wire, 115/230 V. 600 R.P.M.
50 KW Gen. Elec. DLC—Comp. Ind. 125 V.—1150 R.P.M.
50 KW—Northern—Comp. 110 V.—700 R.P.M.

OVER 10,000 STOCK ITEMS



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ELECTRIC MOTORS, Inc.
395 STATE ST.
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FOR IMMEDIATE DELIVERY

TRANSFORMERS

3—500 KVA, GE, type H, form VD525 19100-22000/40000Y to 2300 1 phase 25 cycle.
1—350 KVA, GE, type H-K.D.D. 2300/460—1 PH, 60 Cy.
1—200 KVA Maloney type H.E. 2400/120/240 volts, 1 phase 60 cycle.
3—75 KVA Pitts. 1 Ph. 60 cy. 2300/230/115 volts.

OTHER SIZES, VOLTAGE AND CYCLES AVAILABLE

ALTERNATORS

10 K.W. Gen. Elect. 1 Ph. 60 Cy. 220 Volts—1800 R.P.M.

300 KW Gen. Elect. Synchronous Converter, 6 Phase, type HCC form J, 25 cycle 750 speed with transformers for 2300 volts to 230 volts D.C.

WEST. D.C.—VARIABLE SPEED MOTORS

10—10 H.P. Type S.K. 220 V. 500/1500 R.P.M. with Automatic Dynamic Braking Starters and Field Rheos.

3 ph. 60 cy. A. C. Motors

H.P.	Make		Type	Speed	Volts
200	Wsghse.	Sl. Rg.	CW	600	220/440
150	Gen. Elec.	Sq. Cg.	I.K.	600	2300
100	Gen. Elec.	S. C.	K.T.	720	440
100	Gen. Elec.	S. C.	KT553	1150	440
100	Lincoln		M	1150	440
100	Gen. Elec.	R	MT	600	440

3 ph. 25 cy. Motors

H.P.	Make		Type	Speed	Volts
150	Gen. Elec.	S. R.	IM	500	440
100	Allis Ch.	S. R.		750	440
75	Gen. Elec.	Var.	BTA	375/750	440
75	Gen. Elec.	S. R.	I. M. 17B	160	440
75	Gen. Elec.	Sl. Rg.	I. M.	750	220/440

230 Volt D. C. Motors

H.P.	Make	Type	Speed
150	West.	SK 180L Comp. Wd. Int.	1150
100	Northwestern	K30 Comp. Inter.	1750
50	Crocker Wheeler	CM	625

MOTOR GENERATOR SETS

Gen.-Elect—100 KW. 2 brg. 125 volts D.C. Comp WD-Int. with 220/440 volts, Sq. Cg. Motor.

Rebuilt and Sold with a Standard New Guarantee

Put all idle equipment to work. Send your list for prompt action. WRITE OR WIRE YOUR INQUIRIES

Above KIEMLE OFFERS

L. J. LAND AND COMPANY

DEPENDABLE ELECTRIC EQUIPMENT SOLD WITH A ONE-YEAR GUARANTEE

MOTOR GENERATOR SETS

300 KW West. 250/125 v. d. c. 3 wire type SK 1150 RPM Factory built on C. I. sub-base. Direct Coupled to 3 ph. 60 cy motor with A. C. and D. C. Control.

250 KW G. E. Type MPC 125 v. d. c. 2000 amp. Factory built on C. I. sub-base direct coupled to 3 ph 60 cy motor with A. C. and D. C. Control.

2—500 ampere 60 volt, D.C. Generators, separate excited, variable voltage output for anodizing, etc.

DIRECT CURRENT

(Partial List Only)

230 VOLT DC MOTORS

H.P.	Make	Speed
60	El. Dynam.	900
60	G.E.	480/1100
50	West.	550/1100
50	G.E.	850
45	Diehl	850/1020
40	Cr. Wh.	915
35	West.	1150
25	Diehl	850/1020
25	G.E.	1150
25	G.E.	575
20	R & M	1160
20	G.E.	1150
20	West.	1150
20	G.E.	800 (2)
15	West.	1250
15	G.E.	1150
15	Cr. Wh.	900/1800
15	West.	850
10	West.	850
10	G.E.	825
10	G.E.	700
10	Al. Ch.	600/1800
10	West.	600/1200
10	G.E.	400/1600
10	West.	400/1200
9	G.E.	450/1800
7½	Peerl's	1700
7½	West.	1450
7½	West.	1150 (2)
7½	G.E.	1150
7½	West.	975
7½	Al. Ch.	850
7½	El. Dy.	550/1650
7½	Watson	525/1150
7½	G.E.	400/1600
7½	West.	400/1600
7½	Al. Ch.	350/1050
7½	G.E.	300/1200
6	G.E.	400/1200
6	G.E.	450/1800 (2)
5	West.	850
5	G.E.	900 (2)
5	West.	1800
5	G.E.	1150 (2)
5	Cont.	600/1800
5	West.	850
5	Star	600/1200
5	El. Dy.	550/1650
5	G.E.	450/800
5	G.E.	600
5	G.E.	450/1350
5	West.	400/1200
5	El. Dy.	275/1100

236 additional 230 volt D. C. Motors in stock as small as 1/20 H.P.

BELTED AND MOTOR DRIVEN DC GENERATORS

100 KW West.	250 volts
75 KW West.	250 volts
40 KW G.E.	250 volts
40 KW Reliance	250 volts
50 KW G.E.	250 volts
50 KW West.	125 volts
30 KW El. Dy.	600 volts
40 KW Cr. Wh.	125 volts
30 KW West.	125 volts
25 KW West	125 volts
25 KW G.E.	250 volts
20 KW G.E.	125 volts
15 KW West.	125 volts

43 additional Motor Generator Sets 30 volts, 60 volts, 125 volts, 250 volts, and 250 volts as small as ½ K.W.

ALTERNATING CURRENT

(Partial List Only)

2 & 3 PHASE SLIP RING

H.P.	Make	Speed
450	G.E.	514 RPM
250	G.E.	600
150	El. Dy.	1750
112	G.E.	900
100	Ideal	900
100	G.E.	690
75	West.	1170
75	West.	720
75	Al. Ch.	575
64	G.E.	585
60	West.	1135
60	West.	290
50	G.E.	870 (2)
50	West.	850
48	Wagner	1150
40	F.M.	870
40	West.	870
40	Linc.	690
30	G.E.	870
30	G.E.	690
15/35	West.	6/1200 (5)
25/55	G.E.	6/1200
20/50	West.	6/1200
25	Al. Ch.	870 (2)
25	West.	850
25	G.E.	870 (2)
25	G.E.	720
25	West.	575
20	G.E.	870
20	West.	575

116 additional Slip Ring Motors in stock down to ½ H.P.

3 PHASE SQUIRREL CAGE MOTORS

H.P.	Make	Speed
200	G.E.	600
150	G.E.	860
150	West.	715
100	G.E. (BTA)	375/750
75	El. Dy.	1750 (4)
60	El. Dy.	1750
50	G.E.	1750
75	West.	870
50	West.	1200
50	G.E.	900
40	El. Dy.	1750
40	G.E.	900
35	Wagner	850
30	U. S.	3450 Vert.
30	Al. Ch.	514
25	Wagner	1200
25	West.	1140
25	Diehl	865
25	G.E.	900
25	Wagner	720
20	G.E.	1750
20	G.E.	1200
20	Cr. Wh.	1200
20	Al. Ch.	900
20	Diehl	900
20	G.E.	120
20	West.	1720

15—15 H.P. 4 speed 600/900/1200/1800 RPM Constant H.P. Ball Bearing motors, West. and Louis Allis. 3 ph., 60 cy., 440 volts

15	G.E.	1200
15	Wagner	720
15	G.E.	600
10	G.E.	720
10	G.E.	3450
10	West.	1150

325 additional three phase Motors down to H.P.

SINGLE PHASE MOTORS

H.P.	Make	Speed
20	Wagner	1160
20	Cont.	1165
7½	Cont.	3500

AC GENERATORS

150 KW	G.E.	600 RPM
125 KW	Cr. Wh.	900
100 KVA	West.	600
60 KW	G.E.	1200
25 KVA	West.	1200

New York City's Largest Stock Electrical Machines

ESTABLISHED 1910

146 Grand St. • CAnal 6-6976 • New York 13, N. Y.

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10th & Exeter Sts.

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York, Penna.
323 E. Market St.

LAND

EST. 1910

REMEMBER "U.E.M." FOR THE FINEST IN POWER PLANT MACHINERY

Units listed available for immediate delivery

TURBINE-GENERATOR UNITS

3 phase, 60 cycle

3125 KVA G.E. 180-200 lbs. pressure, 500° TT, 2300 volts, 3600 RPM, equipped with surface condenser, condensing auxiliaries, exciter unit, switchboard with instruments (a complete installation).

1875 KVA G.E. condensing 175-200 lbs. pressure, 500° TT, 6600 volts, 3600 RPM complete with condenser.

937 KVA G.E. condensing 150-175 lbs. pressure, 2300 volts, 3600 RPM with direct connected shaft exciter, surface condenser and auxiliaries.

780 KVA Westinghouse non-condensing 175-200 lb. pressure, 15 lb. back pressure, 480 volts, 3600 RPM, complete with switchboard.

375 KVA G.E. condensing 150-200 lb. pressure, 100° SH, 2300 volts, 3600 RPM complete with surface condenser and auxiliaries.

125 KVA Westinghouse non-condensing, 175-200 lbs. pressure, 0-10 lbs. gauge back, 240 volts with direct connected exciter and switchboard.

ENGINE-GENERATOR UNITS

Direct Current

350 KW G.E. 250 volt, 175 RPM generator, direct connected to a 28"x28" Skinner Universal Unaflow non-condensing engine.

125 KW. 125 volt, 250 RPM generator direct connected to 18" x 16" Elliott engine, 100 lb. pressure, 10 lb. back pressure, complete with switchboard.

75 KW 125 volt, 1800 RPM Westinghouse non-condensing turbine-generator unit.

75 KW 125 volt, 2400 RPM Allis Chalmers Terry non-condensing turbine-generator unit.

15 KW (3) Crocker-Wheeler, 125 volts, 410 RPM generators each direct connected to an American Blower vertical engine.

SPECIAL OFFERINGS

1690 C.F.M. 110 lb. air pressure Ingersoll-Rand steam driven air compressor 125 to 150 lbs. steam pressure.

1590 C.F.M. 100 lb. air pressure Hardie-Tynes steam driven air compressor 150 to 175 lbs. steam pressure.

500 KVA G.E. 3 phase, 60 cycle, 2300 volt, 450 RPM belted generator.

ENGINE-GENERATOR UNITS

3 phase, 60 cycle

Alternating Current

375 KVA Westinghouse 240 volts, 225 RPM generator direct connected to 440 HP, 4 cylinders Nordberg vertical Diesel engine.

312 KVA Elliott, 4000/2300/550 or 240 volts, 180 RPM generator direct connected to a 17"x24" Elliott Unaflow non-condensing engine, 175 lb. pressure, 6 lb. back pressure.

200 KVA General Electric 240 volts, 200 RPM generator direct connected to Skinner Unaflow engine—complete.

FREQUENCY CHANGER SETS

750 KVA Westinghouse, 3-phase, 60 cycle, 2300 volts alternating current generator direct connected to 910 HP, 3 phase, 25 cycle, 2300 volts, 300 RPM synchronous motor.

1200 KVA General Electric, 3 phase, 60 cycle, 2400 volts alternating current generator direct connecting to 1700 HP, 3 phase, 25 cycle, 2300 volt, 300 RPM synchronous motor.

"TWO COMPLETE POWER PLANT INSTALLATIONS"

1—1000 KW 80% P.F.—1250 KVA, 3 phase, 60 cycle, 240 volt, 3600 RPM Elliott alternating current generator direct connected to a 1000 KW, 3600 RPM, 175 to 300 lbs. pressure straight condensing having bleeder opening for 7600 lbs. steam per hour and 10 lbs. extraction pressure, complete with exciter, switchboard panel and instruments, Elliott jet condenser, pumps, piping, valves and fittings. Installed new 1939, equivalent to new.

2—324 HP Babcock & Wilcox-Sterling water tube boilers, National code, 175 lbs. pressure complete with Taylor stokers and all auxiliaries. Excellent condition; new 1922.

2—500 KVA or 400 KW 80% P.F., Westinghouse, 3 phase, 60 cycle, 460 volts, 164 RPM alternating current generators, each direct connected to a 26"x28" Skinner horizontal Universal Unaflow, side-crank, bored-guide, left-hand poppet valve, heavy duty, full floating piston, non-condensing engine, 140 to 160 lbs. pressure, 0 to 10 lbs. gauge back pressure, complete with their exciters, switchboard panels and instruments.

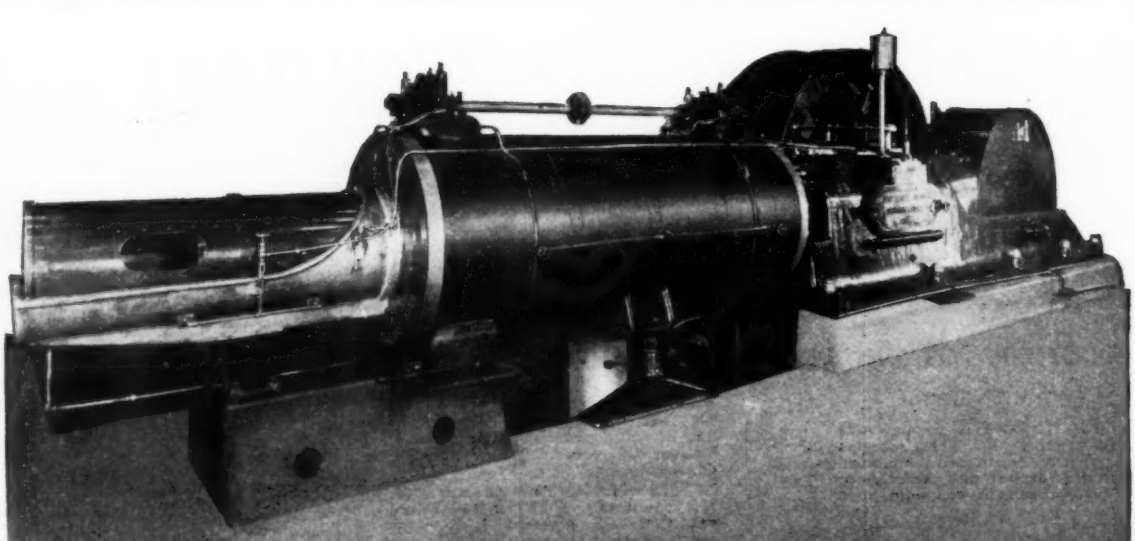
3—407 HP Wickes horizontal cross drum box header type water tube boilers built under ASME and National codes, 160 lbs. pressure, each complete with stoker and all auxiliaries. Two of these boilers are set in one battery and the third in a single battery. This plant is modern in type and construction, and in first-class operative condition.

Utilities Electrical Machinery Corporation

600 NATIONAL CITY BANK BLDG.
CLEVELAND, OHIO

WIRE OR PHONE
LONG DISTANCE 422

POWER PLANT MACHINERY



Actual Photograph

750 KVA SKINNER UNIFLOW UNIT

600 KW 80% P.F. 750 KVA General Electric alternating current generator, 3 phase, 60 cycle, 2300/480/240 volts, 150 RPM, direct connected to Skinner Universal uniflow non-condensing engine, 150 lb. steam pressure, 0-5 lb. back pressure, complete with auxiliaries.

TURBINE GENERATOR UNITS
3 phase, 60 cycle

5000 KVA General Electric condensing turbine generator unit, 2300 volts, 200 lb. steam pressure, with surface condenser

3750 KVA General Electric condensing turbine generator unit, 2300 volts, 175 lb. steam pressure, with surface condenser

3125 KVA General Electric condensing turbine generator unit, 2300 volts, 150 lb. steam pressure, with surface condenser

1560 KVA Westinghouse automatic extraction turbine generator unit, 480 volts, 150 lb. steam pressure, 15 lb. extraction, with jet condenser

937 KVA General Electric condensing turbine generator unit, 2300 volts, 150 lb. steam pressure, with surface condenser

ENGINE GENERATOR UNITS
3 phase, 60 cycle

675 KVA General Electric generator, 2300/480/240 volts, direct connected to Ames uniflow engine, 150 lb. steam pressure

312 KVA Allis Chalmers generator, 240 volts, direct connected to Nordberg uniflow engine, 150 lb. steam pressure

250 KVA General Electric generator, 240 volts, direct connected to Skinner uniflow engine, 150 lb. steam pressure

200 KVA Crocker Wheeler generator, 240 volts, direct connected to Ames vertical uniflow engine, 125 lb. steam pressure

188 KVA Crocker Wheeler generator, 120/208 volts 4-wire, direct connected to Skinner counterflow engine, 125 lb. steam pressure

ENGINE GENERATOR UNITS
250 volts D. C.

500 KW Crocker Wheeler generator, direct connected to Ames vertical uniflow engine, 150 lb. steam pressure

400 KW Crocker Wheeler generator, direct connected to Skinner uniflow engine, 150 lb. steam pressure

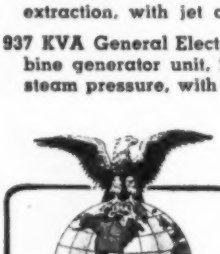
250 KW Crocker Wheeler generator, direct connected to Skinner uniflow engine, 150 lb. steam pressure

RAILWAY RECTIFIERS
600 volts D. C.

550 KW (2) American Brown Boveri mercury arc rectifiers, with 3 phase, 60 cycle, 26400 volt transformers

INDUSTRIAL RECTIFIER
250 volts D. C.

300 KW Allis Chalmers mercury arc rectifier with 3 phase, 60 cycle, 4150 volt transformer



INTERNATIONAL POWER MACHINERY CO.

UNION COMMERCE BLDG. CLEVELAND 14, OHIO

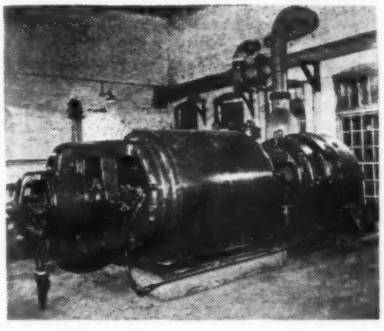
Telephone—MAin 9514

Extraordinary Liquidation

6 COMPLETE POWER PLANTS

Operated by the Georgia Power Company as recently as Dec., 1944

We are listing herewith excellent high-pressure power equipment which has just been released for sale. All this equipment has been maintained in excellent condition and is ready for immediate operation complete with all accessories. Included are all switchboards, motors, panels, transformers, motor-generator sets, exciters, automatic circuit breakers, compensators, rheostats, oil-switches, control-apparatus, pumps, blowers, heaters, piping and all auxiliary equipment. This machinery will move quickly and we urge that you arrange for immediate inspection at the premises.



GENERAL ELECTRIC 2,000 Kilowatt Turbo Generator. Actual Photo As of January 1945.

ATHENS, GA.

1—500 KW Westinghouse Turbo-Generator, 150# Steam Pressure, 2300 Volts, 3 Phase, 60 Cycle, 3600 R.P.M., with Westinghouse-LeBlanc Jet Condenser.
2—370 HP Sterling Water Tube Boilers.
2—390 HP Sterling Water Tube Boilers.
1—600 HP Babcock & Wilcox Water Tube Boiler.
1—300 KW General Electric Rotary Converter, Type HC, 8-300-900, Form P, 60 Cycles, Continuous Current, 600 Volt, 500 Amps., complete with Panel and Transformers.
1—Pawling & Harnischfeger Overhead Trolley Crane.
1—180' Steel Stack (approximate).

AMERICUS, GA.

2—375 KW Allis-Chalmers Turbo-Generators, 160# Pressure, 3600 R.P.M., 2300 Volts, 94.4 Amps., 3 Phase, 60 Cycle, with Wheeler Surface Condensers.
1—575 KW Allis-Chalmers Turbo-Generator, 160# Pressure, 2300 Volts, 157 Amps., 3 Phase, 60 Cycle, with Wheeler Surface Condenser.
1—Maris Bros. Overhead Crane.
2—200 HP Casey Hedges Water Tube Boilers, F-27-38 Foster Superheaters.
1—300 HP Heine Water Tube Boiler.
1—81' Steel Stack.

AUGUSTA, GA.

1—2750 KW General Electric Turbo-Generator, Steam Pressure, 150#, A.C. Generator, Type AQB, Class 4—Form HT, Speed 1800 R.P.M., 2300 Volts, 598 Amps., W. M. Kellogg Co. Twin Bulkley Injector Condenser.
3—400 HP Casey Hedges W T Boilers.
1—500 HP Casey Hedges Water Tube Boiler. Foster Superheater. These Boilers are Oil-Fired, system complete, Automatic Draft Control equipment, etc.

LANGSDALE, ALA.

1—2000 KW General Electric Turbo-Generator, 180# Pressure, 3600 R.P.M. Generator, Type ATB, 600 Volt A.C., 2403 Amps., with Westinghouse-LeBlanc Jet Condenser.
1—750 KW General Electric Turbo-Generator, 150# Pressure, Type ATB, Form HT, 600 Volts, 3600 R.P.M., with Westinghouse-LeBlanc Jet Condenser.
3—308 HP Heine Water Tube Boilers.
1—518 HP Heine Water Tube Boiler.
1—Overhead Trolley Crane—Maris Bros., 20 Ton.

For Further Details

TELEPHONE, WIRE OR WRITE US AT THIS OFFICE OR THAT OF OUR SOUTHERN ASSOCIATES

ATLANTA STEEL AND SUPPLY COMPANY

349 Decatur Street

Atlanta 3, Georgia

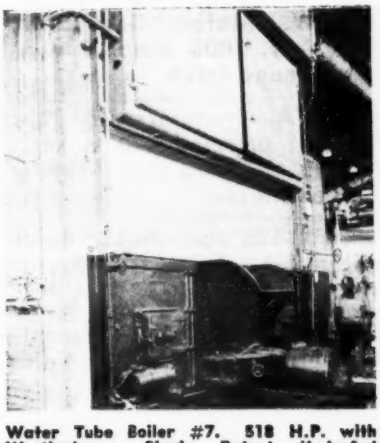
Telephone Walnut 9-4192 Main 5738

GRIFFIN, GA.

1—2000 KW General Electric Turbo-Generator, 2500 KVA, 6600 Volts, 219 Amps., 3600 R.P.M., Type ATB, Form HT, direct-connected Exciter with Elliott Jet Type Condenser.
1—1250 KW General Electric Turbo-Generator, Type ATB, Form HT, 3600 R.P.M., direct-connected Exciter, Wheeler Jet Condenser.
2—512 HP Babcock & Wilcox Water Tube, Sectional Type, 200# Pressure Boilers.

ALBANY, GA.

1—1000 KW General Electric Turbo-Generator, 150# Pressure, Type ATB-2, Form T, 2300 Volts, 314 Amps., 3600 R.P.M., with Worthington Barometric Condenser.
1—600 KW Westinghouse Turbo-Generator, 2300 Volts, 187 Amps., 3 Phase, 60 Cycle, 3600 R.P.M., with Worthington Barometric Condenser.
1—500 HP Sterling Water Tube Boiler.
1—250 HP Walsh & Weidner HRT Boiler.
2—250 HP R. D. Cole HRT Boilers.



Water Tube Boiler #7. 518 H.P. with Westinghouse Single Retort Underfed Stoker—200 lbs. pressure. Actual photo as of January 1945. Boiler—Heine

REPUBLIC TEXTILE EQUIPMENT COMPANY

REFINANCING - APPRAISALS - PURCHASE - SALE - LIQUIDATION OF MILL PROPERTIES

PURCHASE AND SALE OF USED MACHINERY

40 Worth Street, New York 13, N. Y. **Cortland 7-1591**

ELECTRIC EQUIPMENT CO.
63 CURLEW ST. - P.O. BOX 51
ROCHESTER 1, NEW YORK

NEW AND REBUILT

• SPECIALS •

1000 KW. 250 v. steam engine generator set

500 KW. DC generator, 600 v. DC 900 speed, Allis Chalmers. Can assemble motor generator set

120 KW. 250/500 v. DC gasoline engine gen. set

312 KVA. West. synchronous frequency changer, 440 v. 30 cy. input, 440 v. 60 cy. output, 900 rpm.

100 KW. 125 volt, General Electric, 1200 rpm. motor generator set any AC voltage.

100 KW. 250 volt, Westinghouse, motor generator set synchronous drive. Any voltage.

70 KW. Motor Generator Set, 70 v. 1000 Amp. Burke, synchronous drive.

667 KVA. transformers 23,000 volt primary 440 v. sec. 60 cy. single phase. Three units available.

35 KW. 125 volt motor generator set. Any AC voltage drive.

50 — New 3 HP. General Electric, 1800 rpm. 220 volt slip ring motors.

Phone us collect, station to station, on your requirements. Tell the telephone operator who is calling and the reason for the call.

ELECTRIC EQUIPMENT CO.
BOX 51 ROCHESTER, N. Y.
PHONE GLENWOOD 6783

1—440 HP Elec. Machinery, 3-60-440V, 900 RPM, two bearing syn. motor

1—400 HP Westinghouse, type CW, 3 ph. 60 cy. 440V, 450 RPM slip ring motor

1—300 HP General Electric, 3 phase, 60 cycle, 440 volt, 360 RPM, type MT 412 slip ring motor

1—275 HP. Allis-Chalmers, 3 phase, 60 cycle, 440 volt, 1175 RPM slip ring motor

1—200 HP, Allis-Chalmers, 3 phase, 60 cycle, 440 volt, 1150 RPM slip ring motor

1—150 HP, General Electric, 3-60-400V frames 17A 360 RPM slip ring

1—150 HP Westinghouse, 2 ph, 60 cy, 440V frame 1000, CW. 390 RPM slip ring

2—100 HP General Electric, type I, form K, 3-60-220V 575 RPM

2—800 HP, 3 PH, 60 CY, 6600 V Westinghouse, type CW, slip ring 507 RPM mill type motors with liquid slip regulators.

1—150 HP DC Westinghouse type SK, frame 666.3, 600 V. 360/720. RPM ped. type mill motor, #4798360.

1—100 HP Westinghouse, type CCL, 3 ph, 60 cy, 2200 V, 1750 RPM, Squirrel Cage

1—100 HP Allis-Chalmers, type ANY, 3 ph, 60 cy, 220V, 580 RPM slip ring

1—100 HP General Electric, 3 ph, 60 cy, 4000V, 720 RPM syn., type TS with direct connected exciter

2—100 HP Crocker Wheeler, size 2AQ, 3 ph, 60 cy, 440V, 385 RPM slip ring

1—100 HP Westinghouse, type CS, 3 ph, 60 cy, 440V, 1750 RPM sq. cage.

4—75 HP, G. E. 3-60-2300V, 400 RPM, type I, sq. cage

1—75 HP, General Electric, 3 phase, 60 cycle, 440 volt, 450 RPM, type I, form M, slip ring motor

1—75 HP Allis-Chalmers, 3 ph, 60 cy, 440V, 450 RPM slip ring

1—75 HP Fairbanks-Morse, type H, frame 105C, 3 ph, 60 cy, 550V, 900 RPM Squirrel Cage

1—75 HP Lincoln, type IQ, 2 ph, 60 cy, 440V, 600 RPM Squirrel Cage

2—75 HP Fairbanks-Morse, 3 phase, 60 cycle, 2200 volt, 1800 RPM, slip ring motors

1—60 HP Lincoln 3-60-220V frame IXM, Sq. Cage, 900 RPM

1—50 KW factory built m-g set, 125 Volt, Ideal 900 RPM, driven by 75 HP. sq. cage 220/440 V. motor.

1—60 HP General Electric, 3-60-440V, 720 RPM, type I, form K

1—60 HP General Electric, 3-60-440V, 1750 RPM, type I slip ring

1—60 HP General Electric, 3 phase, 60 cycle, 440 volt, 600 RPM, type MT 556 slip ring motor

1—50 HP General Electric 3-60-220V, 1150 RPM, type I, slip ring

1—50 HP Triumph 3-60-440V, type C12, 1150 RPM, slip ring, rotor & stator rewound

1—50 HP General Electric, 3-60-440V, 900 RPM, type I-M, slip ring

1—50 HP General Electric, 3-60-440V, 720 RPM, type IK, Sq. Cage

2—50 HP Allis-Chalmers, 3-60-440V, 890 RPM slip ring

1—50 HP General Electric 3-60-440V, 690 RPM, MT 546, slip ring

1—50 HP Ideal 3-60-440V, 580 RPM, type AV, slip ring

1—50 HP Wagner 3-60-440V, 495 RPM, type BM, Sq. Cage

1—50 HP Allis-Chalmers, 3-60-440V, 490 RPM, Sq. Cage

1—50 HP General Electric, 3-60-440V, 490 RPM, type I-M, slip ring

1—50 HP Westinghouse CS 2-60-440V, 420 RPM, Sq. Cage

1—50 HP Allis-Chalmers, 3 ph, 60 cy, 550V, 860 RPM Sq. Cage

1—50 HP General Electric, type I-M, 3 ph, 60 cy, 440V, 720 RPM slip ring

1—45 KVA Fairbanks-Morse, 3 ph, 60 cy, 220V, 1200 RPM alternator

2—30 HP Fairbanks-Morse, 3 ph, 60 cy, 220V, 3600 RPM, type HO, frame 12B ball bearing

1—50 KW, Allis-Chalmers, factory-built, 3 bearing M-G set, 125 volt DC, driven by 75 HP, 3 phase, 60 cycle, 220 volt, 1165 RPM motor

2—175 HP, 230V, DC Westinghouse, type SK, 150 to 550 RPM

1—100 HP General Electric, type CD, fr. 123, 230V, 1200 RPM

1—60 HP Westinghouse, type SK140L, 115V, 1150 RPM vertical

1—50 HP Westinghouse SK200, 230V, 250/900 RPM

2—40 HP, G. E., 3 ph, 60 cy, 440V, 435 RPM, type 1-13A

25 CYCLE MOTORS

1—50 HP Westinghouse 3-25 cy-440V, 720 RPM, type MS, Sq. Cage

1—50 HP General Electric, 3-25 cy-440V, 700 RPM, type I-M, slip ring

1—40 HP Westinghouse 3-25 cy-440V, 730 RPM, type CI, frame 753A slip ring crane

1—35 HP Allis-Chalmers 3-25 cy-440V, 720 RPM, slip ring

1—30 HP Westinghouse 3-25 cy-440V, 720 RPM, CS, Sq. Cage

The Wente Electric Co.

Hamilton, Ohio

REBUILT MOTORS & GENERATORS SINCE 1906

THE PICK OF POWER EQUIPMENT

TURBINE UNITS—60 Cy.

1—18750 KVA General Electric Cond.
2—15500 KVA Westinghouse Cond.
1—15300 KVA Westinghouse Cond.
1— 6250 KVA General Electric Cond.
1— 5000 KVA General Electric Cond.
1— 4000 KW General Electric Cond.
1— 4000 KVA Allis-Chalmers Cond.
1— 3125 KVA General Electric Cond.
1— 3125 KVA Westinghouse Cond.
1— 3125 KVA General Electric Extrac.
1— 1563 KVA General Electric Cond.
1— 1563 KVA Westinghouse Extrac.
1— 750 KVA General Electric Cond.
1— 625 KVA General Electric Cond.
1— 625 KVA General Electric Non-C.
1— 250 KVA Westinghouse Non-C.
1— 125 KVA Westinghouse Non-C.

D. C. TURBO UNITS

1—1500 KW General Electric 250 V.
2—1000 KW General Electric 250 V.
1— 125 KW General Electric 125 V.
1— 75 KW General Electric 125 V.
1— 50 KW Gen. Elec.-Terry 125 V.
1— 25 KW Westinghouse 125 V.

STEAM ENGINE UNITS—60 Cy.

1—1067 KVA Nordberg Uniflow
1— 375 KVA Nordberg Uniflow
1— 325 KVA Skinner Uniflow
1— 300 KVA Hamilton 4-valve
1— 210 KVA Skinner Uniflow
1— 150 KVA Skinner Uniflow
1— 94 KVA Ridgway 4-valve
1— 93.8 KVA Skinner Uniflow

D. C. STEAM ENGINE UNITS

1—500 KW Ames Uniflow 250 V.
1—400 KW Ridgway 4-valve 275 V.
1—350 KW Ridgway Uniflow 250 V.
1—300 KW Skinner Uniflow 275 V.
1—250 KW Ames Uniflow 250 V.
1—150 KW Ridgway 4-valve 125/250 V.
1—125 KW Ridgway 4-valve 250 V. 3-wire
1—100 KW Elliott 4-valve 250 V. 3-wire

OIL & GAS ENGINE UNITS

1—625 HP Worthington, 240 V. 60 cy. gen.
1—610 HP Campbell, 2400 V. 60 cy. gen.
1—520 HP Busch Sulzer, 2400 V. 60 cy. gen.
1—440 HP Nordberg, 250 V. DC gen.
1—375 HP Worthington, 240 V. 60 cy. gen.
1—300 HP Worthington, 2300 V. 60 cy. gen.
1—300 HP McInt. & Sey., 480 V. 60 cy. gen.
1—283 HP Coop.-Bess. 230 V. 60 cy. gen.
1—175 HP Sterling (gas) 480 V. 60 cy. gen.
3—160 HP Coop.-Bess. 216 V. 60 cy. gen.
1—145 HP Superior, 220 V. 60 cy. gen.
1—125 HP Winton, 240 V. 6 cy. gen.

SURFACE CONDENSERS

1—20,000 sq. ft. Worthington
1—12,000 sq. ft. Worthington
1— 5,000 sq. ft. Westinghouse
1— 4,100 sq. ft. Res

WATER TUBE BOILERS

2—1875 HP B. & W. 285-lb., Stokers
4— 760 HP B. & W. 200-lb., Stokers
1— 750 HP Edge Moor 200-lb.
2— 612 HP Stirling 200-lb.
2— 560 HP Erie City 460-lb.
2— 512 HP Stirling 205-lb.
1— 335 HP B. & W. 200-lb.
2— 300 HP Heine 200-lb.
2— 300 HP B. & W. 160-lb.

A. C. GENERATORS

2—1500 KVA G.E. 25 cy. 2200 V. 750 RPM
2—1250 KVA G.E. 60 cy. 480 V. 750 RPM
1— 500 KVA G.E. 60 cy. 2300 V. 360 RPM
1— 360 KVA West. 60 cy. 240 V. 360 RPM
1— 94 KVA G.E. 60 cy. 2300 V. 600 RPM
3— 62.5 KVA G.E. 60 cy. 220 V. 1200 RPM
1— 48 KW Elec. Mcy. 60 cy. 2400 V. 1200 RPM
3— 37.5 KVA G.E. 60 cy. 220 V. 1200 RPM
2— 25 KVA G.E. 60 cy. 220 V. 1200 RPM

SYNCHRONOUS MOTORS

2—1250 HP G.E. 25 cy. 2200 V. 750 RPM
2—1125 HP G.E. 60 cy. 480 V. 720 RPM
1— 200 HP Ideal. 60 cy. 4000 V. 514 RPM
1— 175 HP West. 60 cy. 4000 V. 514 RPM
1— 150 HP West. 60 cy. 2200 V. 600 RPM
1— 125 HP G.E. 60 cy. 220 V. 720 RPM
1— 100 HP G.E. 60 cy. 2300 V. 240 RPM (Super)

INDUCTION MOTORS—60 Cy.

4—3500 HP G.E. slip ring 2300 V. 120 RPM
1—2500 HP G.E. slip ring 6600 V. 253 RPM
1—1500 HP G.E. slip ring 6600 V. 253 RPM
1—1000 HP G.E. sq. cage 2300 V. 509 RPM
1—1000 HP West. slip ring 2200 V. 360 RPM
1— 500 HP G.E. slip ring 440 V. 450 RPM
2— 400 HP G.E. slip ring 3800 V. 1800 RPM
1— 300 HP G.E. sq. cage 440 V. 1800 RPM
1— 300 HP West. slip ring 440 V. 1200 RPM
3— 250 HP West. slip ring 2300 V. 720 RPM
1— 150 HP G.E. slip ring 440 V. 450 RPM
1— 100 HP G.E. sq. cage 2200 V. 900 RPM
1— 75 HP G.E. sq. cage 440 V. 514 RPM

MOTOR GEN. SETS—60 Cy.

1—1500 KW Allis Chalmers 600 V. DC
1—1000 KW General Electric 600 V. DC
1—1000 KW Westinghouse 250 V. DC
1— 300 KW Westinghouse 600 V. DC
1— 75 KW General Electric 125 V. DC

ROTARIES—60 Cy.

2—2600 KW General Electric 250 V.
2—2500 KW Westinghouse 250 V.
2—1700 KW General Electric 250 V.
1—1500 KW Westinghouse 250 V.
2—1000 KW Westinghouse 250 V.
2— 750 KW General Electric 600 V.
1— 750 KW Westinghouse 225/275 V.
1— 500 KW General Electric 250 V.
1— 500 KW General Electric 600 V.

FREQUENCY CHANGERS

2—12500 KW G.E. 60/25 cy. 300 RPM
2— 5000 KVA West. 25/60 cy. 300 RPM
2— 3125 KVA West. 25/62½ cy. 750 RPM
1— 2500 KVA West. 25/60 cy. 300 RPM
1— 1875 KVA G.E. 25/60 cy. 300 RPM
2— 1250 KVA G.E. 25/62½ cy. 750 RPM
1— 1250 KVA G.E. 25/60 cy. 300 RPM
1— 750 KVA G.E. 60/25 cy. 300 RPM

SYN. CONDENSERS—60 Cy.

1—5000 KVA West. 5000 V. 720 RPM
1—3000 KVA Al. Ch. 2200 V. 900 RPM
1—2000 KVA Elec. Mcy. 460 V. 900 RPM
2—1250 KVA G.E. 480 V. 720 RPM
1— 500 KVA West. 2200 V. 900 RPM

TRANSFORMERS—1 Ph. 60 Cy.

3— 4000 KVA West. 63.5/110-19/33 KV
4— 2500 KVA G.E. 63.5/110-19/33 KV
3— 2500 KVA Pitts. 66000-25400/12700 V.
1— 1500 KVA Pitts. 66000-33000 V. 3 ph.
3— 750 KVA. Pitts. 66000-33000 V.
3— 600 KVA West. 66000-2300 V.
3— 333 KVA G.E. 66000-480 V.
3— 100 KVA G.E. 66000-6900/11000 V.
3— 1667 KVA G.E. 44000-2300/4000 Y V.
4— 1667 KVA Pitts. 33000-2400 V.
3— 200 KVA G.E. 33000-2300/4000 Y V.
3— 150 KVA G.E. 33000-2300 V.
3— 75 KVA G.E. 33000-13200/11000 V.
1—15000 KVA Al. Ch. 27880-4560 V. 3 ph.
2—10000 KVA West. 26400-4580 V. 3 ph.
1— 6000 KVA West. 26400-2300 V. 3 ph.
2— 1000 KVA G.E. 23000/11500-575 V.
3— 667 KVA Packard 23000-440 V.
4— 400 KVA Pitts. 22000/11000-2200 V.
3— 250 KVA G.E. 22000-11000 V.
3— 200 KVA G.E. 22000-230/460 V.
1— 6000 KVA West. 13200-2300 V. 3 ph.
1— 3000 KVA Kuhlman 13800-480 V. 3 ph.
6— 1667 KVA Pitts. 13200-2300 V.
3— 1000 KVA G.E. 13200-2300 V.
3— 200 KVA G.E. 13200-480 V. Pyranol
7— 667 KVA Moloney 11000-2300 V.
1— 150 KVA Pitts. 11000-2400 V.
3— 100 KVA West. 11000-250/125 V.
3— 1250 KVA G.E. 6600-550 V.

VOLTAGE REGULATORS

60 Cycle Induction

6—96 KVA 400 A. 2400 V. Gen. Elec.
1—72 KVA 300 A. 2400 V. Gen. Elec.
2—46 KVA 200 A. 2300 V. West.
6—36 KVA 150 A. 2400 V. Gen. Elec.
6—24 KVA 100 A. 2400 V. Gen. Elec.

OIL CIRCUIT BREAKERS

1— 400 A. 73 KV G.E. FKO36 Outdoor
1— 400 A. 73 KV G.E. FHKO36 Outdoor
1— 400 A. 50 KV G.E. FKO136 Outdoor
6— 400 A. 37 KV G.E. FHKO136 Outdoor
4—4000 A. 34.5 KV Conduit D-16-A Outdoor
2—1000 A. 30 KV Kelman CB76 Outdoor
1— 400 A. 25 KV G.E. FKO136 Outdoor
2— 400 A. 15 KV G.E. FHKO136 Outdoor
1—2000 A. 15 KV West. E6 Indoor
1—1500 A. 15 KV West. E6 Indoor
1—1500 A. 15 KV G.E. FK12 Indoor
6—1200 A. 4.5 KV Condit D-12 Indoor

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW, WOLTMAN & CO., INC.

50 Church Street New York City 7, New York

TURBO-GENERATORS

A FEW OF THE COMPLETE UNITS NOW IN OUR STOCK

1—6250—KVA. G.E. 3 60 2300V. 200#
1—3125—KVA GE 3 60 2300V. 200#
2—1875—KVA GE 3 60 2300V. 200#
1—1000—KW. DC, West. 250; 135 200#
1—1875—KVA. G.E. Non-Cond.
1—937—KVA GE Automatic Extraction 3 60 2300 V. 200 lbs.
2—937—KVA Allis-Chal. 3 60 2300:200#
1—250—KVA GE. Non-Cond. 3 60 480

Also Any Capacity or Type Desired.

WILMS, WEAVER & COMPANY

PENOBSCOT BLDG. DETROIT 26, MICHIGAN

WAGNER

"Certified Rebuilt" ELECTRICAL APPARATUS

M-G SETS

100 KW Gen. Elec. 3 brg. unit, type RC gen. DC 125 v. coupled to 150 HP sq. cage I-K motor 3-60-2200/4000 V.

50 KW Northwestern type 6HH9 rotary converter, input 3-60-220 V., output DC 230 V. with control panel.

50 KW Cr. Wheeler type CC generator DC 125 V. coupled to 80HP C-W motor sq. cage 3-60-220/440 V. 1800 RPM.

30 KW Gen. Elec. CD 103 gen. DC 60 v. 500 amp. coupled to 45 HP G.E. KT 532 motor 3-60-220/440 v. 1160 RPM, late style 3 brg. unit.

1—20 KVA Louis Allis Type ONA b.b. rotary converter DC 230 v. to AC 3 ph. 220 v. 60 cycle 1800 RPM.

Many others available—special units built to order

D. C. MOTORS

H.P.	Mfr.	Type	Volts	Speed
100	Northw'n	interpole	230	1700
100	Reliance	1050T	230	500/1200
50	Whse.	SA	230	450/1350
40	Gen. Elec.	DLC	230	750
40	Roth	S	115	850
30	Sprague	dynamom.	250	800/2000
25	Gen. Elec.	DLC	115	750
25	Roth	elevator	230	725
25	Whse. enclosed	SK	230	600
20	Gen. Elec.	DLC	230	500/1500
20	Fair Morse	TR	230	325/700
20	Whse.	SK	230	850
20	Gen. Elec.	RC31B	230	800
15	Whse.	SK80	230	1150
15	Gen. Elec.	LC	230	550/1100
15	Gen. Elec.	CD83	230	1150
15	Whse. (6)	SK90	230	850
15	Gen. Elec.	CD95	115	575/1725

QUICK SHIPMENT FROM STOCK

SQUIRREL CAGE MOTORS

3 Phase—60 Cycles—220 or 440 Volts

Qua.	H.P.	Mfr.	Type	Speed
1	150	Gen. Elec.	I-K	1200
1	150	Whse. New b. b.	CS771.IS	1800
1	150	Gen. Elec. 2200 v.	I-K	900
1	125	Allis Ch. 2200 v.	AR	1800
1	100	Gen. Elec.	I-K	720
1	75	Whse.	CCL	720
1	75	Gen. Elec.	I-K	600
3	75	Allis Ch. 2200 v.	AR223	1800
1	75	Ideal	A	1200
1	50	Gen. Elec.	KT542	900
4	50	Allis Ch.	AN	900
1	50	Allis Ch.	AN	720
1	40	Gen. Elec.	KT536	900
1	40	Gen. Elec.	I-K	1200
1	40	Gen. Elec.	KT342	720
2	30	Gen. Elec.	KT332	900
2	30	Allis Ch.	AN	1200
1	30	Allis Ch. b. v.	AR220	900
1	30	Allis Ch.	AN	600
6	30	Allis Ch.	AN	900
2	30	Whse. b. b. New	CS405	1800
2	30	Allis Ch.	AN	720
4	25	Allis Ch.	AN	900
1	25	Gen. Elec.	I-K	1200
2	25	Allis Ch.	AN	600
2	25	Diehl New b. b.	IN365	1800
2	25	Louis Allis b. b.	HD	1200
1	25	Whse. New	CS405	1200
6	20	Whse. New	CS364	1800
1	20	Wagner	17TBW	1800
6	20	Allis Ch.	AN	1200
2	20	Gen. Elec.	I-K	1200
3	20	Whse.	CS	900

25 CYCLE MOTORS

H.P.	Mfr.	Type	Speed
450	Whse. 2200 v.	CW sl. rg.	750
300	Whse.	CW sl. rg.	500
150	Whse.	HF sl. rg.	500
150	Gen. Elec. 2200 v.	MT359 sl. rg.	1500
100	Whse.	CCL sq. cg.	500
100	Gen. Elec.	I-K	750
50	Allis Ch.	ANY sl. rg.	1500
50	Allis Ch.	AN sq. cg.	750
30	Allis Ch.	sq. cage	750

SYNCHRONOUS MOTORS

H.P.	Mfr.	Type	Volts	Speed
300	Whse.	ped.	220/440	900
350	Gen. Elec. 3 brg.	ATI	220	360
250	G. E. 1-brg.	ATI	220/440	600
50	Burke		220/440	1200

CENTRIFUGAL PUMPS

14" Foster Wheeler, 5000 gpm @ 45 ft.
10" Weinman, 2500 gpm @ 40 ft.
8" Alberger, 2000 gpm @ 80 ft.
6" Platt, 1000 gpm @ 230 ft.

SLIP RING MOTORS

3 Phase—60 Cycles—220 or 440 Volts

Qua.	H.P.	Mfr.	Type	Speed
1	400	G.E. 2200 v.	I-P	1200
1	350	Allis Ch.	ANY	514
1	300	Burke	EMV	225
1	200	Fair. Morse 3 brg.	BV	600
1	150	Gen. Elec.	I-M	600
2	150	Triumph	SR	514
1	100	G.E. 2200 v.	I-M	900
1	100	G.E. 2200 v.	I-E13A	1800
1	100	Gen. Elec. 3 brg.	I-M	450
1	75	G.E. 2200 v.	I-E13	1800
1	75	Gen. Elec.	MT558	600
1	75	Gen. Elec. 2200 v.	I-M	900
1	65	P. & H. b. b. Int.	CA16	900
2	60	Whse. 2200 v.	CW657	1800
3	60	Gen. Elec.	M-505	1200
1	50	Gen. Elec.	MT536	1200
1	50	Al. Ch. b. b. 2200 v.	ARY	900
1	50	Gen. Elec.	MT342	900
1	50	Gen. Elec.	I-M	600
1	40	Gen. Elec. 2 ph	MQ536	900
1	40	Northw'n	HW35A	1200
2	40	Gen. Elec.	MT532	1200
1	40	Fair. Morse b. b.	HV	900
1	40	Gen. Elec.	MT546	514
1	40	Whse.	CW	900
1	40	Watson b. b.	KHV	1200
1	35	Fair. Morse b. b.	HV	1800
2	30	Northwestern b. b.	HW404	1800
2	30	Allis Ch.	ANY	900
2	30	Whse. enclosed	MA	600

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
250	Northern		250	360
75	Whse.	ped.	125	600
30	Lincoln b. b. 600 amp.		50	1200
25	Gen. Elec.	DLC	125	900
25	Gen. Elec.	LC	250	900
20	Gen. Elec.	RC	250	900
19	Gen. Elec. 300 amp.	CD	65	1200
16	Cr. Wheeler	CCD	125	415

ALSO IN STOCK . . . OIL SWITCHES BLOWERS & FANS . . . SPEED REDUCERS . . . 500 NEW MOTORS

60 CYCLE A. C. GENERATORS

KVA	Mfr.	Type	Volts	Speed
500	Gen. Elec. 3 brg.	ATB	2300	450
300	Allis Ch.		240/480	600
300	Whse.	peu.	240/480	900
300	Elec. Machy.		240/480	720
250	Gen. Elec.	ATB	240/480	600
200	Gen. Elec.	TRB	240/480	720
125	Whse.	ped.	2300	600
100	Allis Ch.		240/480	900
100	Cr. Wheeler		240/480	600
50	Gen. Elec.	ATB	240/480	1200
40	Burke		240/480	1200

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IT TAKES 120,000 SQUARE FEET OF WAREHOUSE SPACE TO HOUSE OUR COMPLETE LINE OF ELECTRIC MOTORS, POWER PLANT EQUIPMENT and REBUILDING SHOPS!

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SLIP RING MOTORS
CONTROL EQUIPMENT
PUMPS
ELECTRIC HOISTS

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933-943 HARRIET ST. — Phone MA. 3024 — CINCINNATI 3, OHIO

TURBO GENERATORS

1—937KVA Gen. Elec. with Wheeler condensor

1—500KW Allis Chalmers Moore non-cond.

1—500KW Gen. Elec. non-cond.

1—300KW Gen. Elec. cond.

ROTARY CONVERTERS

1—1500KW 250V Westgh complete

2—1000KW 250V Westgh complete

The above are just a few of the thousands of items we have in Motors, Generators, Turbo Generators, Engine Generators, Motor Generators, transformers, Circuit Breakers, etc. Please send us your inquiries.

What have you for sale?

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Power Plant Equipment Company

8403 Hegerman St., Phila. 36, Penna.

REBUILT POWER EQUIPMENT

READY TO SHIP!

SLIPRING MOTORS—3 PH., 60 Cy.

H.P.	Make	Volts	R.P.M.	Type
5	G.E.	440	1200	MT
20	Westg.	220	1735	CW
20	Westg.	220	575	CW
25	Westg.	220	720	CW
30	Westg.	220	900	CW
50	Westg.	440	1145	HF
50	Chandeys'n	220/440	1800	
50	Allis Chal.	220	490	
75	West.	220/440/2200	580/290	CW
75	G.E.	220	1200	MT
100	G.E.	220	1800	MT
100	West.	220/440	685	CW
150/75	West.	220/440/2200	580/290	CW
150	West.	2200	375	CW
150	West.	2300	490	CW
150	West.	220/440	490	CW
250	Burke	440	600	EMV-65
250	G.E.	440	900	I
400	Westg.	2300	580	CW
400	Westg.	2200	435	CW-1214
1600	Westg.	2200	435	CW

ALTERNATING CURRENT MOTORS
3 ph. 60 cy.

H.P.	Make	Volts	R.P.M.	Type
25	West.	220/440/550	1200	CS
25	G.E.	220/400	580	KF
30	G.E.	440	1800	KT
30	Line. Elec.	220	600	
30	Duquesne	440	600	
35	Triumph	220	525	TR-138
30	Allis Chal.	220/440	1200	
30	Westg.	220/440	900	CS
30	Westg.	220/440	720	CS
35	Lincoln	220	720	
40	Howell	220	900	SO
40	Line. Elec.	220	900	
40	Duquesne	220/440	850	
40	G.E.	440	1800	KT-527-4
40	Westg.	220/440	1200	CS
40	G.E.	220/440	720	I-K
50	G.E.	220	1200	
50	G.E.	220/440	900	I-K
50	Fair Morse	220	900	
50/150	West.	2200	360/720	CS-954
50	West. Bl.	220	570	KT-346
50	Chandeys.	220/440	1800	
50	Cr. Wh.	240/480	1200	Syn.
50	Allis Chal.	440	1800	AN
50	G.E.	220/440	1200	HI
50/32	G.E.	440	800/640	
60	Duquesne	440	1800	
60	G.E.	220/440	1200	I-K
75	West.	2200/220/440	720	CS
75	West.	2300	1200	Syn.
100	Allis Chal.	220	1750	
100	Allis Chal.	220	600	
150	Wagner	440	1800	31V
150	G.E.	2200/220/440	450/243	
175	G.E.	2200	600	I-12
200	Westg.	2200	900	
400	West.	2200/220/440	500	CS
1000	G.E.	2300	509	K
1500	G.E.	2200/220/440	225	ATI-8yn.
3500/ 4000	West.	4600/23000	900	Syn.

VARIABLE SPEED MOTORS—
230 VOLT D.C.

H.P.	Make	R.P.M.	Type
1.5	Roth	850/1700	
2½	Westg.	450/900	SK-30
2½	G.E.	500/1000	RLC
2½	Reliance	500/1000	14T
3	Jantz-Liest	650/1950	BI-DC
3	Roth (Enclosed)	500/1000	RS
3	G.E.	400/1200	RLC-114
3½	West.	400/1600	SA
3½	Westg.	850/1700	
5	Reliance	600/1800	
7½	Westg.	450/900	80L
7½	Reliance	650/1300	550v.
7½	Westg.	1125/2905	SK-43
7½	West.	400/1600	SA
10	Westg.	565/1130	S-6
10	G.E.	625/1250	LC
10	West.	400/1600	SA
15	Louis Allis	1150/1750	NA
15	Reliance	500/1800	
20	Westg.	7 50/1500	SK-110L
30	G.E.	450/900	RLC
35	G.E.	375/1400	IC
50	G.E.	600/1200	500 v.
50	Westg.	565/1130	SK
75	West.	475/950	SK-180
75	West.	400/650	SK-181
200	G.E.	220/350	MP
200	West. Elec.	220/350	LL-7
250	G.E.	220/320	MP
250	West. Elec.	220/320	LL-7

TRANSFORMERS—1 ph. 60 cy.

No.	KVA	Pri.	Sec.	Make
1	2	6600	110/220	G.E.
3	5	2300	220/440	G.E.
1	5	550	110	Pgh.
1	5	2200	110/220	West.
84	7½	2200	220/110	G.E.
32	7½	2200	220/110	West.
12	10	2200	220/110	West.
13	10	2200	220/110	G.E.
2	15	400/30000/50000		American
1	25	2200	220/110	G.E.
6	35	220	110	West.
3	37½	2200	440/220	West.
3	50	6600	575/440/220	G.E.
2	50	6600	550/440	Pgh.
2	50	6600	550/440	Al. Ch.
2	150	2400	240/480	Allis Chal.
6	73	2200/4000	220/110	West.
6	73	440	205	West.
1	75	2200	220	Burke
6	75	2200	220/440	West.
3	150	2400	240/480	Allis Chal.

INDUSTRIAL TRUCKS

1—Baker Tow Truck with batteries.
1—4000 lbs. Automatic Lift Truck, 50" lift. Platform is 26" x 51½". Overall length of truck 115".

HOIST

1—3 ton Westinghouse Hoist with Westinghouse DC Motor, 1600 rpm.

D.C. CLARK CONTROLLER

1—250 HP Clark Vari-time magnetic controller 230 v. DC reversing, used for plugging service. Can also be used non-reversing.

MOTOR GENERATOR SETS
250 volts

1—5 kw. Allis Chalmers 1150 rpm. Gen. dir. conn. to 220/440 v. 3 ph. 60 cy. Induction Motor.
1—7½ kw. West. 1150 rpm. Gen. dir. conn. to 220/440 v. 3 ph. 60 cy. Induction Motor.
1—10 kw. West. SK 1150 rpm. Gen. dir. conn. to 220/440 v. 3 ph. 60 cy. Induction Motor.
1—15 kw. West. 1150 rpm. Gen. dir. conn. to 220/440 v. 3 ph. 60 cy. Induction Motor.
1—20 kw. West. 1150 rpm. Gen. dir. conn. to 220/440 v. 3 ph. 60 cy. Induction Motor.
1—25 kw. Triumph 1750 rpm. Gen. dir. conn. to 220/440 v. 3 ph. 60 cy. Induction Motor.
1—25 kw. West. 1150 rpm Gen. dir. conn. to 220/440 v. 3 ph. 60 cy. Induction Motor.
1—55 KW 230 v. DC 1200 rpm. West. Gen. dir. conn. to 75 HP 1200 rpm. 2300 v. motor.
1—100 kw. 250 v. DC G.E. Gen. dir. conn. to 2200 v. 3 ph. 60 cy. G.E. Syn. Motor.
1—150 kw. West. 250 v. 900 rpm. Gen. dir. conn. to 290 HP 440 v. 3 ph. 60 cy. West. Syn. Motor.
3—250 kw. Cr. Wh. 250 v. 500 rpm. DC Gens. with 3—250 kva. Cr. Wh. Syn. 2200 v. 3 ph. 25 cy. Motors.

125 volts

1—3 kw. G.E. 1800 rpm. Gen. direct driven by 220/440 v. AC Induction Motor.
1—5 kw. 125 v. 1150 rpm. Allis Chal. Gen. dir. conn. to 3 ph. 60 cy. 220/440 v. AC Induction Motor.
1—50 kw. G.E. 1200 rpm. Gen. direct driven by 2200/440/220 v. AC Induction Motor.
1—100 kw. 125 v. West. Gen. with 2300 v. 3 ph. 60 cy. 1200 rpm. West. Syn. Motor.

500 volts

1—200 kw. West. 600 v. DC 900 rpm. Gen. dir. conn. to 290 HP 440 v. 3 ph. 60 cy. West. Syn. Motor.

A.C. GENERATORS

62½ KW Westg. 3 ph. 60 cy. 240/440/2300 v. 1200 rpm.
360 KVA West. 220 v., 3 ph. 60 cy., 360 rpm.

SPEED REDUCERS

1— 36 HP Cleveland Model 150, size 900 AT, ratio 43:1.
1— 40 HP W. A. Jones 480 rpm. ratio 9.143:1.
2— 50 HP W. A. Jones 575 rpm. ratio 9.143:1.
1— 75 HP W. A. Jones 875 rpm. ratio 9.143:1.
1—100 HP W. A. Jones 1150 rpm. ratio 9.143:1.
1—125 HP Nuttal, single reduction, ratio, 1.6:1 450 rpm.
1—150 HP Nuttal, single reduction, ratio 1.6:1.
1—175 HP Jones 1750 rpm. ratio 9.143:1.
2—180 HP Cleveland size 1000 AT ratio 9-2/5:1.
1—225 Nuttal, ratio 1.6:1.
1—300 HP Nuttal, ratio 1.6:1.
1—400 HP Nuttal, ratio 1.6:1.

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120 HP late Fairbanks Morse Diesel
240 and 280 HP Fairbanks Diesel Generator
375 and 500 HP Fulton Diesel Generators
3000 cu. ft. 500 HP M.D. Air Compressor
300 cu. ft. 60 HP M.D. Air Compressor
2—80" x 20' HRT Rebuilt Steam Boilers
2—80 HP Steel encased HRT Boilers
10 and 50 ton Steel Derricks & Hoists
25 Ton Steam also Gasoline Loco. Cranes
25 Ton Diesel-Electric Switch Engine
1¼ yd. P & H gas crawler crane. Rebuilt
2 yd. Williams H. Duty clamshell bucket
Water Tube Boilers—Air Compressor
Steel Sheet Piling—Pile Hammers, etc.

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150 KW MOTOR GENERATOR SET

150 KW Westinghouse "factory built" Synch. Motor Generator Set. Type SK Generator for 250 volts DC compound wound interpole, 225 HP Type G Synch. Motor for 3/60/2300 volts, speed 900 RPM, complete with Westinghouse Switchboards.

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Special Offerings

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1—4000 KW. 2300 V. Cond.
1—2000 KW. 600 V. Cond.
1—1500 KW. 2300 V. Cond.
1—1250 KW. 480 V. Cond.
1—750 KW. 2300 V. Cond.
1—750 KW. 600 V. Cond.
1—500 KW. 125 V. D.C. Cond.
1—200 KW. 2300 V. Cond.
1—120 KW. 440 V. Von. C.
1—75 KW. 125 V. Non. C.

TURBINES ONLY

1—375 H.P. with gears
1—210 H.P. Terry 250#
1—100 H.P. G.E. with gears

ENGINE GENERATORS

1—600 KW. 2300 V.
1—125 KW. Uniflow 600 V.

BOILERS

1—2100 H.P. 350# Stoker
4—1000 H.P. 250# Oil
1—480 H.P. 225#
1—300 H.P. 225# Stoker
2—300 H.P. 160# Oil
1—200 H.P. 450# Oil
1—168 H.P. 150# Oil
1—150 H.P. 150# H.R.T.

AIR COMPRESSORS

1—6700 C.F. 22# Turbine Driven
1—1600 C.F. 50# Steam Driven
1—1315 C.F. 30# Steam Driven
1—1214 C.F. 100# Motor Driven
1—600 C.F. 350# Steam Driven
1—386 C.F. 100# Steam Driven
1—105 C.F. 350# Motor Driven

PUMPS

1—3000 GPM 65' Hd Motor
1—1000 GPM Fire Pump Steam
1—750 GPM Fire Pump Steam

CONDENSERS

1—6000 Sq. Ft. Surface
2—2212 Sq. Ft. Surface
1—3200 Sq. Ft. Surface
1—1485 Sq. Ft. Surface

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The Buyer Must Be Satisfied—Always

CHICAGO'S LARGEST STOCK GUARANTEED EQUIPMENT

MOTOR GENERATOR SETS

KW	Make	DC	Volts	AC Volts
1200	G.E.	280	Syn.	3/60/4100
1000	G.E.	250	Syn.	3/60/4150
1000	G.E.	600	Syn.	3/60/2300
1000	Wtg.	275	Ind.	3/60/4100
750	Wtg.	275	Syn.	3/60/440
235	Wtg.	125	Syn.	3/60/2200
225	Ideal	125	Syn.	3/60/2200
200	Elliott	125	Ind.	3/60/2200
150	Al. Ch.	250	Syn.	3/60/2300
100	Al. Ch.	125	Syn.	3/60/440
100	Wtg.	250	Ind.	3/60/440
100	Wtg.	250	Ind.	3/60/2200
100	G.E.	250	Ind.	3/60/2200
75	G.E.	250	Ind.	3/60/440
75	G.E.	125	Syn.	3/60/220
60	Al. Ch.	110	Ind.	3/60/2200
50	G.E.	250	Ind.	3/60/440
25	G.E.	230	Ind.	3/60/220
22½	G.E.	125	Ind.	3/60/220
15	Ideal	220	Ind.	3/60/220
10	G.E.	115/230		Balancer set
7½	G.E.	60	Ind.	3/60/440
7½	Jen	115/230		Balancer set
	Roth	125/250		Balancer set
3½	G.E.	230	Ind.	3/60/220
	Lincoln	115	Ind.	1/60/220
3	Lincoln	115	Ind.	1/60/220
3	Westg.	25	Ind.	3/60/220
2½	Acme	45	Ind.	3/60/220
2¼	Wotton		Ind.	1/60/110/220
2.4	Lincoln	80	Ind.	3/60/220
3HP	Roth	110	2 KVA	1/60/110
2	El Sp.	750	Ind.	3/60/440
1	Holtz. C	65		220 D.C.
5	Rob. M.	115	* Variable voltage	
.378	G.E.	110	Ind.	1/60/110
.250	Robbins	125	Ind.	1/60/125
.250	Roch.	120	Ind.	1/60/110/220
.2	G.E.	6		115 v. d.c.
.2	G.E.	6	Ind.	1/60/110/220

FREQUENCY CHANGERS

1400 HP General Electric type ATI-24-1250M-300, form C, 3 ph., 60 cy., 460 volt, 300 RPM, 1570 amps., 1250 KVA, 0.9 P F 50° synchronous motor with amort. wdg.; dir./conn. to 1000 KW General Electric type AT-10-1250M-300, 3 ph., 25 cy., 460 volts, 300 RPM, 1570 amps., 1250 KVA, 0.8 P. F. 50° A C generator with amort. wdg., with 33 KW G.E. 125 volt direct connected exciter (This is a three brg. unit suitable for operation from either end.)

40 KW Howell, SR-5454, 3 phase, 60 cycle, 440 volt to 40 HP 3 phase, 25 cycle, 40 volt, SC-443, .8 P. F., 750 GM, 4-brg. set.

SLIPRING MOTORS

3 Phase, 60 Cycle

Qu.	HP	Make	Type	Speed
2	2500	G.E.	MT	253
1	1000	Westg.	CW	450
1	1000	Westg.	HR	360
1	1000	G.E.		400
1	850	Allis Chal.		1180
1	800	Westg.	CW	360
2	800	Westg.	CW	507
1	800	Westg.	CW	900
1	750	Allis Ch.		440
1	750	G.E.	I-P	900
1	700	G.E.	MT-10	710
1	600	Westg.	with drive	350
1	600	West.	CW	390
1	500	G.E.	MT412	435
1	500	G.E.	MT412	450
1	450	G.E.	MT412	600
1	400	Westg.	CW	435
1	400	Allis Chal.		600
1	400	G.E.	I-M	720
1	400	G.E.		1200
1	400	G.E.	IP	1800
1	350	Allis Chal.		300
1	350	G.E.	MT	300
1	350	G.E.	I-M	900
1	300	G.E.	I-24	293
1	300	Westg.	CW	400
1	300	G.E.	I-P	450
1	300	G.E.	MT-410	450
1	300	Westg.	CW	500
1	300	G.E.	I	514
1	300	G.E.		720
1	250	Westg.	CW	435
1	250	Cr. Wheeler	SR27QB	600
1	250	G.E.	IM	435

SQUIRREL CAGE MOTORS

3 Phase, 60 Cycle

Qu.	HP	Make	Type	Speed
1	1000	G.E. 2200 v.	K	509
1	700	G.E. 2200 drip-proof cons.	KF	1800
1	600	Fair. Morse	H2	212
1	500	G.E.	IK	1200
1	500	Westg.	CS	1750
1	400	Allis Chal.		600
1	400	G.E.	I-M	950
1	400	G.E.	I-K	1800
3	250	Westg.	CS	350
1	250	Ideal	A	1200
4	250	Fair. Morse	BB	1800
1	225	G.E.	I-E	1800
1	225	G.E.	FT	3600
1	200	Allis Chal.	AN	347
1	200	Fair Morse		514
1	200	Westg.	CS	600
1	200	G.E.	IK	600
1	200	G.E.	KT566	720
3	200	G.E. 2200 v.		1800
3	200	Fair Morse	BB	1800
1	200	Westg.	CS	3600
2	200	G.E.	KTP	3600
1	150	Allis Chal.		570
1	150	G.E.	IK	600
1	150	Westg.	CS	1800
2	120	G.E.		720
2	150	G.E.	I-K	720
1	150	Allis Chal.		850
1	150	G.E.	K-558	900
1	150	Westg.	CS	1800
4	125	G.E.	KT	720

DYNAMOMETERS

250 HP GE Sprague type C dynamometer, laboratory test type 250 volts 1200/1500 RPM with Scale beam & control panel.

50 HP G.E. Sprague block test type, 275 volts, 750/2000 RPM, with complete panel.

5—25 HP GE Sprague type LC shunt interpole, block test with control panels 825/2000 RPM.

1—Type TLC-110, 250 HP, 1000/3000 RPM 250 V. BB. All Complete.

SYNCHRONOUS MOTORS

HP	Make	Volts	Speed
600	G.E.	2200	600
500	G.E.	2200	720
500	G.E.	2200	450
300	G.E.	440	900
270	G.E.	440	600
190	E.M.	440	720
150	E.M.	440	1200
5	G.E.	220	1800

COMPLETE POWER PLANT

1—750 KW bleeder type turbine 3 phase, 60 cycle, 480 volts, 190 lbs. 10 lbs. exhaust, bleed at 75 lbs. with all auxiliaries,

2—633 HP water tube boilers, 225 lbs. with all fittings, oil burners,

1—865 HP vertical tubular ASME, all piping and valves.

SPECIAL MOTOR-GENERATOR SET

300 KW Crocker Wheeler type CCD 250 volts, with 500 HP G.E. type TS syn. motor, 2200 v. 450 RPM.

PLATER

7500 ampere 6/12 volts Electric Products unit, with 100 HP GE type TS syn. motor with tank, etc.

CHICAGO ELECTRIC CO. 1320 W. CERMAK RD. CANAL 2900 CHICAGO 8, ILL.

MOTORS • GENERATORS • TRANSFORMERS

MOTORS

25 Cycle—3 Phase—2200 Volts

3—150 HP, Gen. Elect. Ball Bearing type KT557Y 1500 RPM. Serial # over 5 million

MOTOR GENERATOR SETS

1—40 KW Gen. Elect. 230 V. DC. Type DLC. Direct connected to 50 HP. Gen. Elect. KT. Motor 3/60/440 V. 720 RPM.

1—125 KW Ridgeway 250 V. DC. 1200 RPM. direct connected to 180 HP. Ridgeway Motor. 3/60/440 Volts 1200 RPM. DC. Panel and Starting Compensator.

SPECIAL OFFER

1—75 HP. Westinghouse Slip ring motor. 3/25/220/440/550 RPM. Sealed Sleeve Bearing.

FREQUENCY CHANGER SET

1—1250 KVA Gen. Elec. Synchronous—motor 3/25/2200 750 RPM direct connected to Generator 362½/440 V. Complete with exciters and panels.

25 CYCLE SYNCHRONOUS MOTOR

1—100 HP. Electric Machinery Co. Synchronous. Motor 3 phase 25 cycle, 440 Volt 300 RPM.

TRANSFORMERS

3—150 KVA. General Electric Type H. Form KS. 2400 Volts Primary 120/240 Volts Secondary.

60 CYCLE MOTOR

1—200 HP. Electric Machinery Synchronous Motor, 3 phase 60 cycle 440 Volt, 720 RPM.

REBUILT MOTORS

3 Phase 60 cycle 220/440 Volts

HP	Make	Type	RPM	Serial No.
7½	General Electric	KT952	1200	4593120
7½	Fairbanks-Morse	HJ-10BB	900	157685
7½	Fairbanks-Morse		1200	476598
10	Westinghouse	CS	900	2174616
10	Star	BB	3600	90847

HP	Make	Type	RPM	Serial No.
15	U. S.	STB-BB	720	55379
15	Crocker Wheeler		600	131413
15	Westinghouse	CS	1200	1883285
15	Westinghouse	MS	1200	944593
20	Westinghouse	CS	1200	2160590
20	Star	BB404	1200	10581
20	Westinghouse	MS	1200	1056826
20	Westinghouse	MS	1200	1246745
20	Westinghouse	MS	1200	1056827
20	Westinghouse	CS	1800	1863526
20	Westinghouse	CS	1800	1930159
20	Westinghouse	CS	1800	2695044
25	Westinghouse	MS	1800	1562026
25	Westinghouse	MS	1800	1334763
25	Westinghouse	CS	1200	2286768
25	Westinghouse	MS	1200	1197673
25	Wagner	BP	1200	126906
30	Armor	BB	720	4343
30	Crocker Wheeler		720	17270
30	Westinghouse	MS	1200	1197674
30	Fairbanks-Morse	V-H-10D	1800	43476
40	Westinghouse	CCL	350	581480
40	Westinghouse	CS	900	1896969
40	General Electric	I-K	1800	73318
40	General Electric	I-K	1800	68511
40	General Electric	I-K	1800	77017
40	General Electric	I-K	1800	73316
40	Westinghouse	MS	1800	1506800
40	Westinghouse	MS	1800	1051548
40	Westinghouse	MS	1800	1056802
40	General Electric	I-K	1200	181444
40	Westinghouse	MS	1200	1027421
50	Westinghouse	CCL	400	541841
50	Westinghouse	MS	1800	1289389
50	Westinghouse	MS	1200	854410
50	Westinghouse	CS	1800	2691183
50	Westinghouse	CS	1800	1949877
50	General Electric	14	1800	181444
50	Reliance		1800	Z20194
50	Allis Chalmers		1800	3K28825
60	Westinghouse	CS	900	4884402
60	Reliance		1200	B11458
60	Westinghouse	CCL	450	518408
60	General Electric	I	1800	292596
60	Westinghouse	CCL	1800	329654
60	Robbins-Myers	K	1800	P515362
60	Triumph		1800	C14248
60	Westinghouse	CCL	1200	854121 (2200 v.)
75	Westinghouse	CCL	514	450185

HP	Make	Type	RPM	Serial No.
75	Westinghouse	CS	1800	2134671
100	Westinghouse	CCL	600	416173
100	Westinghouse	CS	900	2207524
100	Westinghouse	CCL	1800	1043213
100	Westinghouse	CCL	1800	765231 (2200 v.)
125	Westinghouse	CCL	720	427284
125	Westinghouse	CS	1200	2318625
150	Westinghouse	CS	1800	2429726
150	Westinghouse	CCL	900	438385
150	General Electric	KT557	1200	5269860
150	General Electric	KT557	1200	5260126
150	Westinghouse	CS	1200	4572596 (2200 v.)
150	General Electric	I-K	720	122809 (2200 v.)
150	Westinghouse	CCL	720	808349 (2200 v.)
200	General Electric	I-K	900	232917 (2200 v.)
200	Westinghouse	CCL	900	919537 (2200 v.)
250	General Electric	I-K	600	2246834
300	General Electric	I-K	720	2357743
400	General Electric	I-K	900	2347845

SLIP RING MOTORS

3 Phase 60 cycle 220/440 Volts

HP	Make	Type	RPM	Serial No.
1	Westinghouse	CW	1200	5348371
1	General Electric	MT122	1200	232163
1	General Electric	MT122	1200	3797828
1	General Electric	MT122	1200	2323624
1½	General Electric	MT140	1200	1416002
1½	General Electric	MT140	1200	811798
15	General Electric	I-M	900	1225064
15	General Electric	MT322	855	3088717
13	K.W. Sachsenwerk	D7-3/8	850	295481
20	Westinghouse	CW644C	575	8009992
20	General Electric	MT332	545	3889010
30	Westinghouse	HF	1745	1558408
40	Westinghouse	CW748	690	4406823
40	Westinghouse	CW748	690	4406825
40	Westinghouse	CW748	690	4406821
40	Westinghouse	CW748	690	4406819
40	Westinghouse	CW748	690	4405824
250	Allis Chalmers	3 bearing	505	1043390 (2300 v.)
400	General Electric	I-M	900	224674
400	General Electric	I-M	900	246762

ERIE ELECTRIC CO., INC.

124 CHURCH ST. BUFFALO, N. Y. CL. 4758

SPECIAL OFFERINGS NON-CONDENSING TURBOS

1—1000 KW Wemco 60/3/2300V/1800 RPM/150#-10# B.P.
1—1000 KW Wemco turbine only. 375#, 700° T.T. Good condition
2—750 KW Allis-Chalmers 200#, 100° S.H. 10# B.P. 75 extraction 60/3/2300/3600 RPM.
Complete plant 750 KW Moore 200# 100° S.H. 10# B.P. 75# extraction with 2 633 HP boilers.
1—625 KW-780 KVA Wemco Parsons 60/3/480V, 200#. 5# B.P. 100° S.H.
1—600 KW Wemco Parsons 60/3/440V/140# ISP
1—500 KW-625 KVA Wemco mult. expans. parallel flow 60/3/440V/3600 RPM 150-200#-10# B.P.
1—400 KW-500 KVA 60/3/480V/150#-5# B.P. with reduction gear. Used only 3 mos.

COND. TURBOS

12,500 KVA 2-6250 KVA Wemco 76 CW frame, 60/3/2300/200# equal new.
5,000 KW G.E. Curtis 5 stage Cond.
4,000 KW G.E. 60/3/2300V, 200# 125° S.H. jet or surface cond.
2,000 KW Wemco 60/3/440V/180#, surface cond.
1,250 KW Wemco Cond. or Bldr. 60/3/480V/150#/120° S.H. /3600 RPM economical Cond. Bldg. 15# G, 15,000# per hr.
1250 KVA Allis A.C. 60/3/2300/3600 RPM 150-200#, 100° S.H. with jet condenser, all aux. Rugged turbine, price low.
1560 KVA Wemco A.C. 60/3/600/3600 RPM, with mixed flow regulator and Wemco 42 sq. ft. surf. cond.
300 KW Wemco high speed 60/3/2400V. All aux. including boiler complement.
SPECIAL: 1—3000, 1—2500 KW G.E. power generating plants, complete with code boilers. Condition good.

ASME BOILERS

1—1250 HP steam generation plant, complete. Superheater, Economizer, Steel encased with 14 retort underfeed stoker, 100,000# continuous.
2—612 HP 200# 125° S.H. Stirling.
4—500 HP Heine 190#, 150° S.H.
2—500 HP B&W 200# 100° S.H. with Comb. Eng. Type E. stokers; all aux.
3—400 HP 1—500 HP Casey Hedges; oil fired.
2—365 HP Edgemoor 200# 100° S.H. ASME ramy type stoker.
3—354 HP Stirling 160# all aux. ASME Detroit underfeed stokers.
3—316 HP Heine horizontal 170# waste heat.
1—313 HP 250# Edgemoor, 125° S.H. with stoker.
2—300 HP Stirling 170# 100° S.H. B&W ASME
2—252 HP 225# 3 drum, bent tube, with oil burners, new in 1937 used 1 year.
2—200 HP Bigelow HRT 130#, Huber stokers.

50 YEARS OF SERVICE

LET US PLACE YOUR MODERN IDLE EQUIPMENT

POWER PLANT EQUIPMENT CO., Inc.

39 Cortlandt Street
New York, N. Y.

A C TURBINE UNITS

6250 KVA G.E., 2300 V., cond.
3750 KVA G.E. 2300 V. cond.
3750 KVA Wghse. 600 V. BLEEDER
3125 KVA G.E., 4100/2300 V. cond.
3125 KVA G.E., 480 V., BLEEDER.
2500 KVA G.E., 2300 V. cond.
2500 KVA Al. Chal. 440 V. cond.
1875 KVA G.E., 2300 V. cond.
1553 KVA Al. Chal. 480 V. cond.
1250 KVA (2) G.E., 2300 V. cond.
937 KVA G.E. 2300 V. cond.
937 KVA (2) G.E. 2300 V. BLEEDER.
625 KVA Wghse. 2300 V. cond.
375 KVA G.E., 2300 V. cond.
312 KVA Elliott 480 V. cond.
250 KVA Al. Chal.-Elliott Kerr, 240 V.
150 KVA Wghse. 240 V. cond.

(NON COND.)

375 KVA G.E., 2300 V.
312 KVA C.W.-Moore, 450#, 240 V.
280 KVA E.M.-Terry.
110 KVA Al. Chal.-Elliott Kerr.
75 KVA Al. Chal. 240 V.
190 HP Wghse. 375# Turbine.
150 HP Terry, 225# Turbine.

BOILERS

850 HP B&W W. T. Boiler 250# with Riley Stoker.
728 HP Erie City, Ver. 200#.
612 HP Sterling 250# Chain Gr. Stoker.
522 HP Kidwell 207# 3 drum.
480 HP (2) Springfield 225#.
471 HP Erie City Ver., 160#.
396 HP B. & W., 160#.
300 HP (2) Union Iron Wks. Cross drum 175#.
287 HP (2) B&W 160#.
259 HP (3) Wicks ver.; 160# pulver.

DIESEL ENGINE SETS

375 KVA Wghse.—Busch Sulzer.
312 KVA G.E.—Anderson.
300 KVA Fairbanks-Morse "VA".
219 KVA Burke—Buckeye.
200 KVA G.E.—Busch Sulzer.
125 KVA Ideal Primm.
118 KVA (2) Ideal—Winton.
105 KVA Ideal Primm.
90 KVA (4) F.M.—F.M. "VA".
75 KVA Al. Chal.—International.
65 KVA F.M.—F.M. "VA".

SPECIALS

300 KVA Al. Chal. 3/60/240 v.—Elliott Kerr Turbo, non-cond.
300 KW G.E. 240/120 v. 3 wire dir. cur. — Skinner Uniflow Engine.
312 KVA Wghse. 2/60/550 v.—Skinner Uniflow Engine.
300 KVA Fairbanks Morse "VA". Diesel engine unit.
287 HP. (2) B&W Boilers 160#.

STEAM ENGINE SETS (A C)

675 KVA Burke—24x36 Nordberg Unif.
480 KVA Al. Chal.—Corliss 4 V.
375 KVA G.E.—22x27 Erie Ball 4 V.
312 KVA Wghse.—21x22 Skinner Unif.
300 KVA G.E.—Ames UNIFLOW (Twin)
250 KVA G.E.—Nordberg UNIFLOW.
250 KVA Al. Chal.—Al. Chal. Corliss.
150 KVA G.E.—16x16 Skinner S.V.

PUMPS (MOTOR DRIVEN)

3250 GPM Morris 425' head.
1000 GPM Al. Chal. 246' head.
1000 GPM Morris 255' head.
800 GPM Al. Chal. 325' head.
725 GPM Wheeler 30' head.
700 GPM Ingersol 566' head.
420 GPM (2) Worthington 630'

STEAM ENGINE SETS 250 V.

450 KW C. W.—Nordberg Unif.
400 KW G.E.—Ridgway 4 V.
300 KW G.E.—Skinner Unif.
250 KW Allis Chalmers Corliss.
250 KW C.W.—Skinner UNIFLOW.
150 KW G.E.—Erie Ball 4 V.
100 KW G.E.—Erie Ball 4 V.

AIR COMPRESSORS

2200 CFM Nordberg 100#. Steam and Motor Driven.
1080 CFM Nordberg—100#.
599 CFM Ingersol—100#.

SYNCHRONOUS CONDENSER

5000 KVA Wghse. 3-60-2300/4000 V.

GAS ENGINE UNITS

1000 KVA G.E. 3-60-2300 v.—1200 HP. Rathburn Jones Gas Engine.
115 KVA Al. Chal.—Cooper Bess.
156 KVA (2) G.E.—Bruce MacBeth.

TRANSFORMERS

100 to 3333 KVA, all voltages.

★ ★ ★ FOR SALE ★ ★ ★

POWER PLANT, formerly of the North Works
of the American Steel and Wire Company,
either as an entirety, or in individual pieces;

10 STEWART BOILERS, 150 HP,

5 OIL BURNERS

Also, NARROW GAUGE TRACK AND LOCOMOTIVES

For additional information, apply to

Worcester Grove Realty, Inc.

288 MAIN STREET, WORCESTER 8, MASSACHUSETTS
Tel. 3-7261

SYNCH. CONVERTERS

600 KW AL-CH. 250 D.C. 2300/4000 A.C. 1200 RPM
600 KW G.E. 600 D.C. 2300/4000 A.C. 1200 RPM
150 KW WEST 250 D.C. 2300/4000 A.C. 1200 RPM

MOTOR GENERATORS

500 KW WEST. SYN. 250 V. 2300 A.C. 900 RPM
200 KW G.E. IND. 600 V. 2300/4000 A.C. 1200 RPM

Each unit listed above is owned by us and is available now for immediate purchase.

WALLACE E. KIRK CO.
Incorporated
502 Grant Building Pittsburgh, Pa.

COMPRESSORS

526 CFM Ingersoll Rand, Style "J"
940 CFM Ingersoll Rand, Type 10 hor. 2 st. steam driven, with receiver
599 CFM Ingersoll Rand type XB10 M.D. with 100 HP, 3/60/440 motor

CRUSHERS

No. 3 and No. 6 McCully Crushers

HOISTS & HOIST MOTORS

(Write for our complete list!)

SHOVELS

#2 Koehring 3-way comb. Crane, Dragline & Shovel
320-B 6½-yd. Electric Stripping

TRACTOR WAGONS

7, 7½ yd. cap. Allis Chalmers Speed-Ace Tractor Wagons

—— Request Bulletin! ——

TANK AND TOWER

60,000 gallon Water Tank on 89'9" tower, with 10" riser pipe.

IRON & STEEL PRODUCTS, INC.
13438 S. Brainard Ave., Chicago 33, Illinois
"*ANYTHING* containing IRON or STEEL"

POWER PLANT BARGAINS

1—450 HP 6 cylinder, 4 cycle Full Diesel Engine, direct connected to Westinghouse 375 KVA, 3 ph. 60 cyc. 240 RPM AC Generator, dir. con. Exciter, Switchboard & Auxil. Equipment.
1—200 KW G.E. Turbo-Generator 3 ph., 60 cyc., 480 volt, 3600 RPM 150# non-condensing.
1—110 HP Washington 4 cyl. 4 cycle, Full Diesel Engine, 600 RPM.
1—100 KW G.E. Turbo-Generator 3 ph. 2300 volt, 60 cyc., 3600 RPM ATB 125# non-condensing.

SUNDFELT EQUIPMENT CO.
3422 First Ave. South
SEATTLE 4, Wash.

—TRANSFORMERS—

BOUGHT and SOLD

We have several thousand transformers in stock for prompt shipment, and invite your inquiries

PIONEER TRANSFORMER REBUILDERS

We rewind, repair and redesign all makes and sizes.

One Year Guarantee

THE ELECTRIC SERVICE CO., INC.
"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
STATION M Since 1912 CINCINNATI 27, OHIO

STEAM PUMPING ENGINES

1—Snow 8 MGD C&FW cr. Com. Opp. Type Cond. 26x54x17x36, with waterworks type condenser.
1—Snow 6 mgd. C&FW Cr. Com. Opp. Type Cond. 20-40x14¾x36, with waterworks type cond.
1—Allis-Chal. 4 mgd. cr. com. cond. Size 12x28x13x24. All fine cond.
1—Platt Iron Wks. Cr. Comp. C&FW Meyer Valve Gear Cond. 1000 GPM. Size 14x28x9¼"x18.

PUMP VALVES

Birch Valves for all types of reciprocating pumps.

LARGE GATE VALVES

1—20" Rensselaer #13 Iron Body Bronze Mounted Hub End Gate Valve with 16" Iron Brass Lined Hydl. Cyl. with indicating Rod and Eyebolt. 100#.

BIRCH MANUFACTURING COMPANY
1523 Sedgwick St. Chicago, Ill.

SLIP RING MOTORS
3-HP., 60-CY

HP	Volts	Make	Speed
900	2200	G.E.	900
350	220/440	G.E.	1800
300	2200	G.E.	1800
300	2200	Whse.	514
300	440-220	Al. Ch.	900
250	2300	G.E.	600
250	440-550	G.E.	600
200	2200-550	G.E.	1800
200	2200-400	G.E.	600
150	440-220	G.E.	1800
150	440	G.E.	1800
150	550-2200	G.E.	1800
150	550	G.E.	720
125	2200	G.E. (NEW)	1800
125	440-220	G.E.	600
100	550-2200	G.E.	720
100	440-220	G.E.	1800
100	220-440	G.E.	720
100	220-440	G.E.	900
100	440-220	G.E. MTC	900
75	220-440	G.E.	900

SYNCHRONOUS MOTORS
3-HP., 60-CY

600	2200	Whse.	900
350	440-220	G.E.	900
300	440/220	Al. Ch.	600
200	2200	Whse.	900
110	440	Whse.	900
100	2200-550	Al. Ch.	1800
100	440-220	G.E.	360
75	440-220	G.E.	720

PUMP

1—8" Dredge Pump 1880 GPM, 120' Morris Machine Works with direct connected Slip Ring Motor 125 HP, 600 RPM, G.E.

UNAFLOW ENGINE-GENERATOR SET consisting of:
Gen: 250 KW 200 RPM 250 volt direct connected to:
Eng: 23" x 24" Ames Unaflow 125/150# ga. non-condensing. Very modern—practically new.
1—11" x 12" Ames non-condensing Steam Engine, direct connected to a 60 KW Crocker-Wheeler 250 volt DC Generator.

TRANSFORMERS
60 CYCLE

3—500 Kva., G.E., Type H, Form KDD 13200-2300 V.
3—500 kva., G.E., type H, form KS, 13800-230/460
3—333 kva., G.E., type H-KDD 2400-400/230.
3—250 kva., Whse., 13,800-460.
3—200 kva., G.E., type H, 34500-2300 V.
1—200 kva., G.E., type HT, 13200/26400/480 V. 3 ph.
3—150 kva., G.E., type H KDD, 6600/11430Y 1300 V.
3—150 kva., G.E., type H-KDD 13200-2300.
3—150 kva., Al. Ch., type OISC 10400-2400.
3—100 kva., G.E., type H 2400-240-480.
3—100 kva., G.E., type H-KDD, 6900/11950Y-220/115.
3—100 kva., G.E., type H-KR 6600/11430Y-2300 V.
2— 75 kva., G.E., type HK, 2300-230/115.
3— 50 kva., Moloney, 2300-230/115.
6— 50 kva., Whse., type SK, 13800-240/120.
3— 50 kva., whse., 22,000-2300.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G.E.	IK	1200
550	440/220	G.E.	IK	900
300	2200	G.E.	IE-K	1800
250	2200	G.E.	IK	1600
250	2200	Whse.	CS	1200
250	440/220	G.E.	IK	1800
200	220/440	G.E.	IK	720
200	440/220	G.E.	IK	900
150	440/220	G.E.	IK	900
150	2200	Allis Ch.	AN	450
150	440/220	Whse.	CS	514
125	440/220	G.E.	KT	1800
100	2200	G.E.	IK	600
100	2200	G.E.	IE-K	1800
100	550	G.E.	KT	900
100	220/440	G.E.	KT	720
75	2200	G.E.	KT	900
75	2300	G.F.	IE-K	1800
60	550	G.E.	FT	3600
50	220/400	G.E.	K	1800

MOTOR GENERATOR SETS

1—125 KW, 125 V., 1200 RPM, G. E. conn. to 175 HP, 1200 RPM, 440 V. 3 ph. 60 cy. Syn. motor.
1—75 KW, 250 V. 850 RPM, conn. to 110 HP, 440/220 V. Sq. Cage Motor.
1—50 KW, 250 V. 850 RPM, Whse. conn. to 75 HP, 440/220 V. 3 ph. 60 cy. Sq. Cage Motor.

A.C. GENERATORS

1—500 kva., 900 r.p.m., 2209 V. Whse. Condenser.
1—300 kva., 900 r.p.m., 240/480 V., G.E.
1—187 kva., 900 r.p.m., 550 V. Whse.
1—110 kva., 900 r.p.m., 440 V., G.E.
1— 96 kva., 360 r.p.m., 480/240 V. G.E.
1—62½ kva., 1200 r.p.m., 2200 V. Cr. Wh.
1— 60 kva., 720 r.p.m., 240/480 V., G.E.
1— 25 kva., 3600 r.p.m., 220 V., G.E.

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2— 600 H.P. Edge Moor 200# Stokers
1— 570 H.P. B. & W. Sectional 200#
1— 600 H.P. B. & W. Stirling 200# with Stoker
6— 440 H.P. B. & W. Sectional 200# Oil fired
1— 335 H.P. B. & W. Sectional 200 Boiler
Smaller Boilers and Fire Tube Boilers also

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1—10000 K.W., G.E. Co., Turbo-Generator Condensing
1— 5000 K.W., G.E. Co., Turbo-Generator Condensing
3— 4000 K.W., G.E. Co., Turbo-Generator Condensing
2— 2500 K.W., G.E. Co., Turbo-Generator Condensing
2— 2000 K.W., G.E. Co., Turbo-Generator Condensing
1— 2000 K.W., W. E. & M. Co., Turbo-Generator Con.
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1—Ideal 50 HP 600 RPM 2300 Volt

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Allis-Chalmers 250 HP 600 RPM 440 Volt
G.E. 62½ HP 1150 RPM 440/220 Volt

SQUIRREL CAGE MOTOR SPECIAL
3 phase, 60 volts

5—West. frame 405, 20 HP 900 RPM TEFC 220 Volts.

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A large number of adjustable speed D.C. motors from 5 to 150 HP

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Rot. Con.—M-G Sets 3 ph. 60 cy.

2—300 KW G.E. HC 12 Rotaries 275 v. 6 ph. with 2300 v. 3 ph. 60 cy. Transformers.
100 KW West. 125v—2200/440/220 Syn.
100 KW Ridg. 250v—2200/440/220 Syn.
50 KW G.E. 125v—220/440 Ind.

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2—225 KW G. E. 250 v. 325 RPM. DC.
200 KVA G.E. 2200/3/60 720 RPM. AC.
75 KW G.E. 125 v. 700 RPM. DC.
50 KW G.E. 125 v. 1750 RPM. DC.
45 KW West. SK 125 v. 700 RPM. DC, AC, and DC Steam Gen. Sets.

AC & DC STEAM GEN. SETS

100 KW West. 250 v. DC—Skinner
57½ KVA Al. Ch. 220/3/60 3600 RPM Turbo
50 KW West. 125 v. DC—Skinner
50 KW 125 v. DC Westgh. Turbo Gen.

AC MOTORS 3 ph. 60 cy.

HP	Make	Type	Speed	Wdg.
1500	West.	CW	435	S.R.
1000	G.E.	KT	514	S.C.
500	G.E.	MT 412	435	S.R.
300	West.	CW	495	S.R.
200	G.E.	IM	495	S.R.
200	West.	S P. F.	900	Syn.
200	G.E.	MT 412	240	S.R.
150	G.E.	S P. F.	900	Syn.
150	West.	CW	375	S.R.
150(2)	West.	CCL	600	S.C.
125	G.E.	IK	720	S.C.
125	Al. Ch.	ANY	435	S.R.
100	G.E.	IK	1150	S.C.
100	G.E.(25 cy)	MI 108	490	S.R.
50/12½	G.E.	IM	450/900	S.R.
50	G.E.	KT	1160	S.C.
40	Triumph	TR	1760	S.C.
25	G.E.	KT	1160	S.C.
25	West.	CW	575	S.R.

Also large number of smaller motors.

MISCELLANEOUS

1—355 cu.ft. 100# 12 x 10—ER 1 Ing. Rd.
500/700 HP Morse Chain 4.28 to 1
250 HP Falk Gear 12.7 to 1
150 HP Nuttal 1.6 to 1

DC MOTORS

HP	Make	Type	Speed	Voltage
250 (2)	G.E.	MP	220	230 cp.
230	G.E.	MD109.5	475	500 ser.
175	G.E.	MD8 109.5	475	230 ser.
130	G.E.	CO 1812	550	230 ser.
140	West.	MC 90	500	500 ser.
105	G.E.	CL	700	230 cp.
100	G.E.	MD 108	550	230 ser
100	G.E.	DLC	575	110 cpd.
60	G.E.	CO 2507	600	230 ser.
50	West.	SK 160	575	230 cp.

Also large number of smaller motors

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PUMPS MOTOR & STEAM DRIVEN

G.P.M.	Head	Make	Type
9700	110′	Ing. Rand	Centrif.
6000	33′	LeCourtenay	Centrif.
3500	140′	Kingsford	Centrif.
2400	55′	American	Centrif.
1100	220′	Allis-Chalm.	Centrif.
1500	160′	De Laval	Centrif.
400	625′	LeCourtenay	Centrif.
250	825′	LeCourtenay	Centrif.
400	350′	Goulds	Triplex
300	500′	Goulds	Triplex
175	500′	Goulds	Triplex
500	175′	Blackmer	Rotary
450	231′	Kinney	Rotary
300	150′	Viking	Rotary
1000	460′	Knowles	Steam
750	460′	Snow	Steam
500	460′	Worthington	Steam
2000	50′	Lawrence	Sump
300	231′	Gardner	Plunger

M. G. & STEAM DR. SETS

K.W.	Make	Volts	Type
25	Green Eng.	220 D. C.	Belt Drive
100	Ames	240 D. C.	dir. dr. Eng.
75	Ames	240 D. C.	dir. dr. Eng.
17	Sturt. Turbine	110 D. C.	Direct Drive
7½	Sturt. Turbine	110 D. C.	Direct Drive

D.C. MOTORS ALL SIZES

100 Northwest	230	1750
25 Roth	230	1750
10 Crock. Wheel	110	925
10 Weeks.	110	1700

½ to 7½ H. P. ALL MAKES

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Nash-Jenn Dup. Vac. Heat. 26000EDR
Nash-Jenn Simp. Vac. Heat. 16000EDR
Condensation Units 100 to 250,000EDR

AIR COMPRESSORS

C.F.M.	Pressure	Make	Type
850	100	Laidlaw	Hor. Dup.
500	60	Ing. Rand	Steam
400	125	American	Horiz.
350	40	Worthing	Horiz.
125	100	Gardner	Vert. Dup.
173	100	Ing. Rand	Horiz.
28	5000	Norwalk	4-Stage

TURBO-CENTRIFUGAL BLOWERS

3000	16 lbs.	In. Rand	Motor dr.
3000	8 lbs.	In. Rand	Motor dr.
900	5¼ lbs.	In. Rand	Motor dr.
700	2½ lbs.	Allen Billmyer	Motor dr.
675	24–45 oz.	Spencer	Motor dr.
250	3.2 lbs.	Spencer	Motor dr.
250	16 oz.	Spencer	Motor dr.

BLOWERS & EXHAUSTERS

C.F.M.	St. Pres.	Make	Type
100–60000	¼"–5"	Buffalo	Various
100–15000	¼"–16 oz.	American	Various

ROTARY PRESSURE BLOWERS

C.F.M.	Press	Make	Type
15000	2 lbs.	I-R-Turbo	Direct dr.
6000	3 lbs.	Roots	Belt dr.
3000	3 lbs.	Roots	Belt dr.
2000	3 lbs.	Sturt.	Belt dr.
1000	3 lbs.	Roots	Belt dr.
200	5 lbs.	Baker	Direct dr.
110	15 lbs.	Beach R	Belt dr.

VACUUM PUMPS

1000	15 in.	Roots	Belt dr.
350	27 in.	Worth	Belt dr.
100	high vac	Beach R	Gear dr.
100	27 in.	Deane	Belt dr.
100	29 in.	Devine	Belt dr.

MOTORS (3 ph. 60 cy.)

HP	Make	Volts	Speed	Type
300	G.E.	2300/4000	1800	Syn
150	West.	440	700	CS
125	G.E.	220	1150	Vertical
100	Lincoln	220	1750	
50	G.E.	2300	1750	I
50	West.	220	850	CCL
50	West.	220	570	CS
40	G.E.	220	870	342
30	Wagner	220	850	sl. rg.

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4000 K.V.A. COND.—NON COND. TURBO

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1—800 A. Conduit E4 600 V. 3 PST. Handle, Trip Coils and Currents.
1—1200 A. GE FK 132 A 3 PST 7500. Handle with Trip Coils and Current Tranformer.
1—2000 A. GE CK 8 Air Breaker 3 PST 600 V. O.L. & U.V.
1—3000 A. GE FK 25 Oil Breaker 3 PST 600 V. Solenoid operated with currents.

Sq. Cage.—220/440 V. 60 Cy. 3 ph.

Qu.	HP	Make	Type	Speed
2	50	G.E.	KT 327	1800
2	100	G.E.	IK	1800
1	150	West.	CS	1800

Slip Ring—220/440 V. 60 cy. 3 ph.

1	40	West.	CW	720
1	50	G.E.	I-M	900
1	60	G.E.	I-M	900
1	75	West.	CW	900
1	250	West.	CW	1200

D. C. Variable Speed 230 V.

1	15	West.	SK	400/1600
1	25	West.	SK	400/1200
1	50	West.	SK	500/1500
1	50	G.E.	CD	400/1600

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200 H.P. Fairbanks Morse, 3/60/2200 V. Generator.
280 H.P. Fairbanks Morse 32-D Diesel, 3/60/480.
360 H.P. Ingersoll-Rand, 3/60/2300 Volt Generator.
500 H.P. Fairbanks Morse 33-D Diesel, 3/60/480.

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4—72" x 18' HRT boilers including a 637 KVA General Electric condensing turbine. Complete plant.
2—175 HP Brownell HRT Boilers, 150# pressure, rebuilt.

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15,000 KVA Westinghouse turbine, condenser.
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1—625 KVA Nordberg Uniflow engine.
1—1060 KVA Nordberg Uniflow Engine Generator.

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1—200 KVA Fairbanks-Morse Full Diesel Engine Generator.
1000 KVA Diesel Generator Plant complete.
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1250 KVA Nelseco engine generator

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1—250 KVA Skinner Uniflow Engine, panel board, 3-60-240 Volts.
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1—7 ft. diameter by 175 ft. self-supporting stack.

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54,000 pound Cochrane hot process lime and water softener.
2500 HP Cochrane Open Feed Water Heater.
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2—6 Retort Taylor Stokers. First-Class condition.
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1—232 GPM Centrifugal Boiler Feed Pump, turbine driven, 1200 ft. head.

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1—360 HP 14x17, Y-VA Fairbanks, 257 RPM
1—300 HP 14x17, Y-V Fairbanks, 257 RPM
1—200 HP 14x17, Y-V Fairbanks, 257 RPM
1—150 HP DelLaVergne, 225 RPM
2— 60 HP Y-VA Fairbanks, 257 RPM
4—125 HP Busch-Sulzer, 327 RPM
1—120 HP Y-VA Fairbanks, 257 RPM
1—120 HP Atlas-Imperial, 500 RPM
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2—365 HP Busch-Sulzer, 16¼x21, 327 RPM

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200 KW. 720 RPM. 3/60/240 V. General Elec. ATB

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1—Rotation AR1 (Starboard)
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1—Flywheel Type Flexible Coupling
1—Woodward Governor
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1—Torsional Balance Wheel
1—Sub-Base
1—Set ABS Spare Parts
1—M96 Canvas Cover
1—145 KVA, 101 KW, 70% PF, type TGZD, 480 volt, 400 RPM, #420589 A.C. generator 40°
1—ABS Test and Certificate
1—Set ABS Spares
1—7½ KW, 400 RPM, 125 volt shunt wound type DG, 40° engine type exciter, #X64669
1—ABS Test and Certificate
1—ABS Set of Spares

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(2) single set 404 H.P. (each) sectional steel header straight tube cross drum boilers, 10' setting heighth, complete with stop valves (no firing equipment), built by Springfield Boiler Co. in 1925 for 170#, retubed with #10 gauge tubes few months before shutting down.

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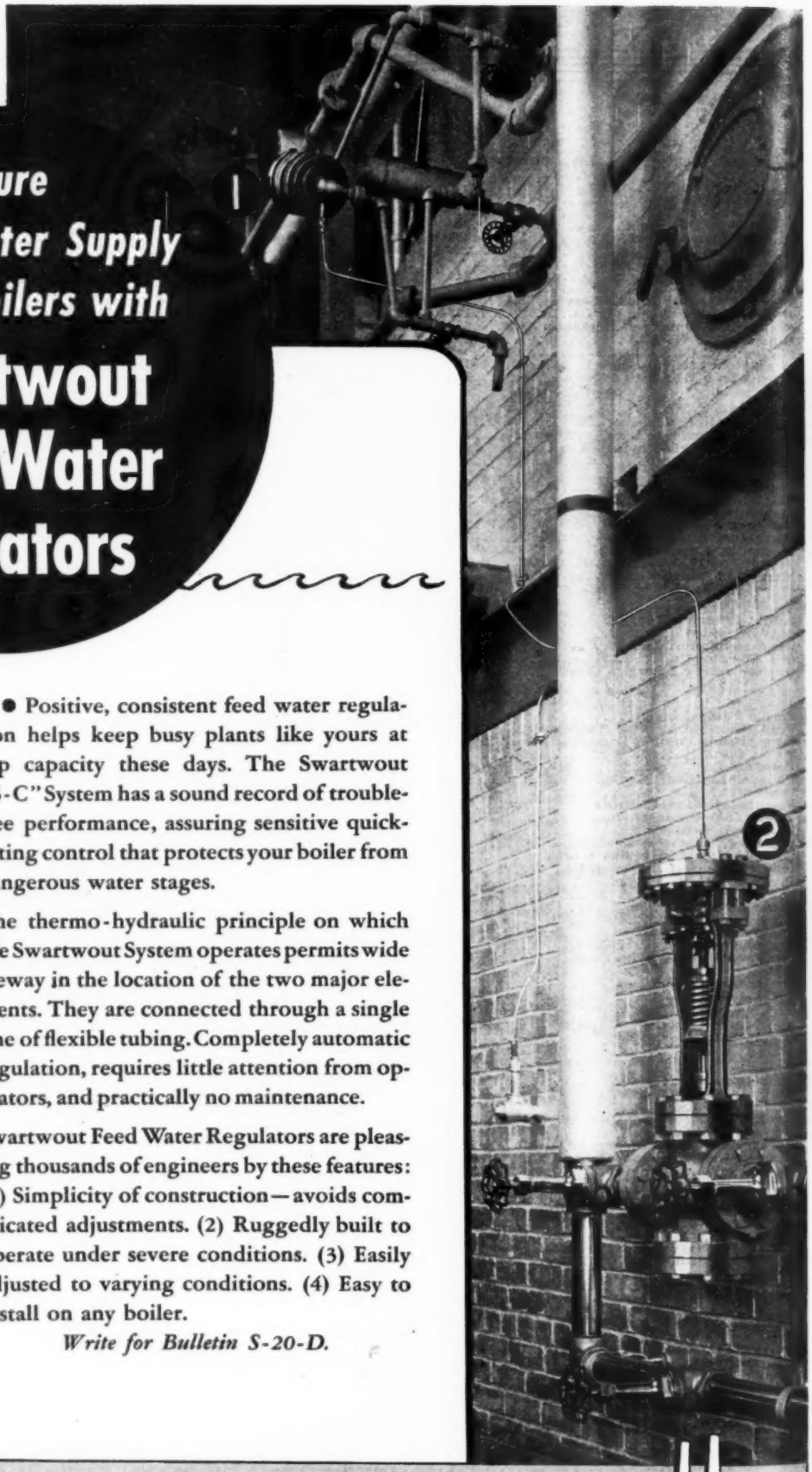

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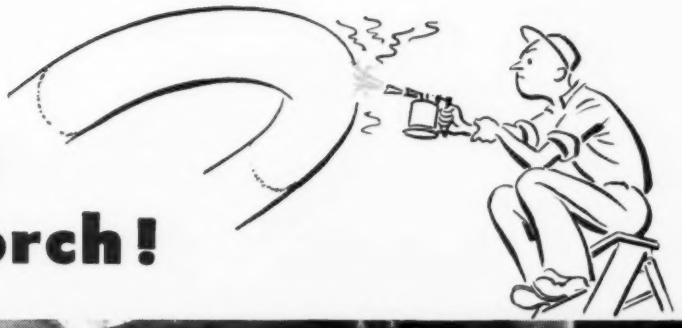

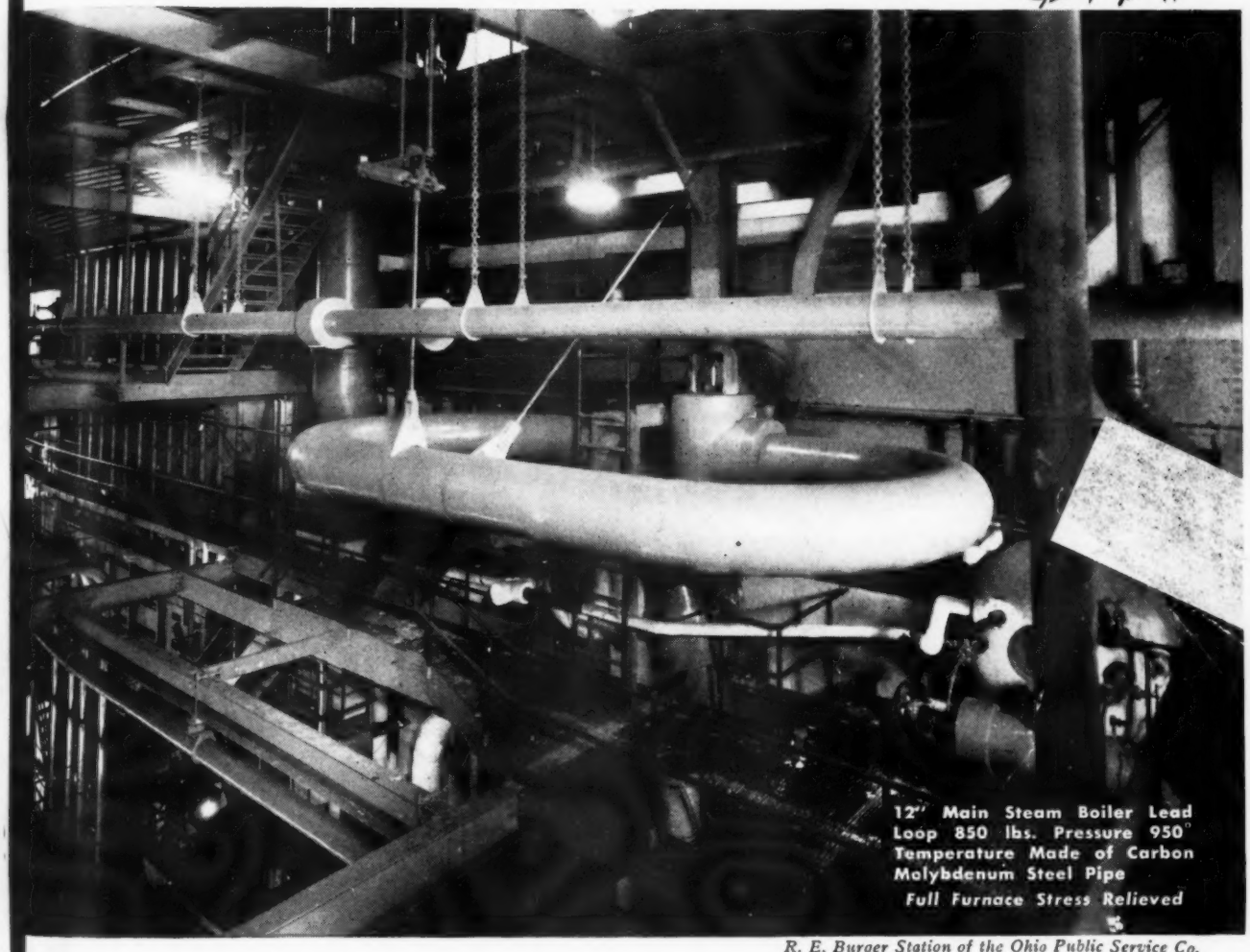
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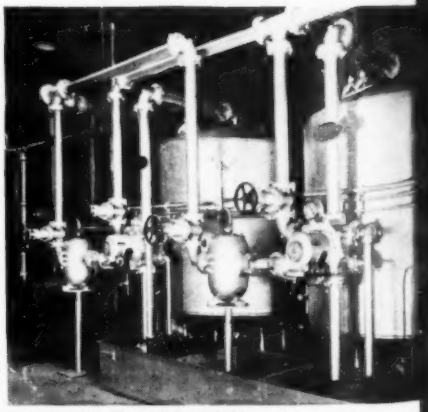

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